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Technical Report 65-2

AD 44-188

# Human Factors in Tactical Nuclear Combat

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by

Robert Vineberg

April 1965

Prepared for:

Office, Chief of  
Research and Development,  
The Department of the Army

Contract DA 44-188-ARO-2

# HUMRRO

The George Washington University  
**HUMAN RESOURCES RESEARCH OFFICE**  
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**THE DEPARTMENT OF THE ARMY**

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SPRINGFIELD, VA 22161

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The Human Resources Research Office is a nongovernmental agency of The George Washington University, operating under contract with the Department of the Army (DA 44-188-ARO-2). HumRRO's mission, outlined in AR 70-8, is to conduct research in the fields of training, motivation, and leadership.

The contents of this publication do not necessarily represent the official opinion or policy of the Department of the Army

Published  
April 1965  
by  
The George Washington University  
HUMAN RESOURCES RESEARCH OFFICE  
300 North Washington Street  
Alexandria, Virginia 22314  
Distributed under the authority of the  
Chief of Research and Development  
Department of the Army  
Washington, D.C. 20310

## FOREWORD

The U. S. Army Combat Developments Command (USACDC) requested the Human Resources Research Office, in December 1963, to undertake a study designed to provide information on the probable effectiveness of soldiers in tactical nuclear battle and on the probable behavior of civilians exposed to tactical nuclear warfare. In addition, HumRRO was asked, if possible, to devise a method by which human factor considerations could be introduced into the conduct of war games.

The study was undertaken by HumRRO as Technical Advisory Service. An interim report was presented to the Combat Developments Command in May 1964. The study, as described in this report, was completed and reported to USACDC in September 1964.

The study was performed by Dr. Robert Vineberg. Dr. Eugene A. Cogan made major contributions in the development of the model for adjusting casualty rates, based on psychological factors, for use in war gaming. Mr. William E. Montague provided valuable assistance in the survey of the literature.

Appreciation is extended to the Medical Statistics Agency, Office of the Surgeon General, Department of the Army, for providing detailed World War II data on wounded and neuropsychiatric casualties.

Appreciation is also extended to the many authors whose works are quoted in the various discussions of human behavior under conditions of stress. Permission of copyright holders for reproduction of copyrighted material has been obtained.

Research of the Human Resources Research Office is conducted under Army Contract DA 44-188-ARO-2 and under Army Project 2J024701A712 01, Training, Motivation, Leadership Research.

MEREDITH P. CRAWFORD  
Director  
Human Resources Research Office

## **SUMMARY AND SELECTED IMPLICATIONS**

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### **The Problem**

The probable response of man to the psychological trauma of nuclear battle is largely unknown. Nevertheless, in order to make realistic plans for military action as well as to prepare man himself to operate under such conditions, it is necessary to have an estimate—as accurate as the state of our knowledge will permit—of the psychological effects of nuclear warfare.

The general objectives of this study are to draw together information that may provide bases for predicting human behavior in nuclear warfare, to analyze this information for implications concerning possible preparation for such warfare, and to develop a means for estimating the psychological casualties that are likely to occur on the nuclear battlefield.

### **Approach in the Study**

Since direct information about the psychological consequences of nuclear warfare is not available, an estimate of the consequences that might be expected must be based primarily on evidence drawn from the military and research literature on behavior in conventional combat, non-nuclear disasters, and other extreme stress situations.

Part I of the report is a summary description and an analysis of man's response to extreme stress, based on a review of relevant literature. Among the major topics discussed are:

(1) The behavior of civilian populations under aerial bombing (including Hiroshima and Nagasaki) and in civil disasters such as floods, fires, earthquakes, or hurricanes. Special attention is given to effective and ineffective responses in such situations, including a discussion of panic.

(2) The behavior of military personnel in combat, with special reference to levels of combat effectiveness, and factors that bear on the development of psychological disorders in combat (e.g., intensity and duration of stress, nature of the tactical situation, training and preparation, and group supports and relations).

(3) The psychological mechanisms involved in coping with these and other instances of extreme stress, such as major surgery or terminal illness.

(4) On the basis of the above information, a preliminary consideration of needs, problems, and methods of preparing the soldier for the nuclear battlefield.

Part II of the report is a description of the method, or model, which was developed for estimating the extent of psychological casualties that can be expected as a consequence of tactical nuclear battles. The model provides for the adjustment of battle casualty rates to allow for neuropsychiatric (NP) casualties as a function of both combat intensity and amount of time in combat. The rationale for the procedure, and the sources and probable magnitude of error are discussed.

### **Selected Conclusions and Implications**

(1) Evidence taken from a wide variety of situations involving severe stress and trauma, and viewed in the light of what is known of man's behavior throughout history, indicates that man can, and generally does, hold up remarkably well under the severest

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forms of stress. The evidence suggests that man can cope with the entire range of stress situations—even those in which he faces inevitable death.

(2) This evidence has led to the proposition that in general man would act in tactical nuclear combat much as he has always acted in combat. Stress on the nuclear battlefield may be greater than that in warfare as man has known it in the past, and psychological casualties may therefore increase in number. There is, however, no evidence to suggest that there would be sharp qualitative changes in man's response to such increases in stress. The mode<sup>1</sup> for estimating casualty rates for psychological attrition is based on this assumption.

(3) In general, the effectiveness of a soldier in combat first increases and then decreases. Initial low effectiveness is due both to a lack of knowledge and proficiency in those techniques necessary for operating in battle and to the disruptive effects of emotion. With additional combat experience the soldier's effectiveness rises because of his gain in combat proficiency. He is less likely to become a battle casualty; at the same time, however, the likelihood of his becoming a psychological casualty begins to increase. After some period of time the soldier reaches maximum effectiveness, and then a period of decreasing effectiveness ensues. These effects manifest themselves in psychological disorders as well as other forms of battle failure or ineffective behavior, such as hanging back or participating minimally in battle.

(4) The most important factor affecting the frequency of psychological disorders and the rate at which NP casualties occur is cumulative stress, which arises primarily as a joint function of the duration of man's exposure to battle and the intensity of battle.

(5) Specific factors affecting NP casualty levels that appear to be of particular significance for nuclear combat are:

(a) *Fatigue*. Fatigue interacts with combat stress, increasing the probability that a man will become an NP casualty. The anticipated highly mobile, rapid, and continuously changing nature of nuclear combat would probably result in fatigue greater than that typical of conventional combat, and thus a higher incidence of NP casualties. High NP rates found among the highly mobile armored troops in World War II appear to support this contention.

(b) *Isolation*. Isolation, itself a source of stress, reduces man's capacity for resisting the effects of stress. In nuclear combat the individual soldier will be more likely to feel isolated because separation from his primary group, disintegration of his primary group, and loss of contact between his group and higher headquarters are all more likely.

(c) *Ambiguity*. Disruption of communications and rapid and frequent changes in the combat situation, in addition to the unknown and ever-possible danger of radiation injury, would operate to increase the uncertainty of the individual soldier about what may be happening to him. It can be expected that the ambiguity normal to combat would be greater in nuclear battle, with consequent increases in stress and fear.

(6) The method of management of NP casualties has an effect on the number of casualties and on the likelihood of their returning to combat. If for nuclear combat there is any policy of removing all types of casualties to rear areas for diagnosis or treatment, a considerable increase in the number and permanence of psychological casualties should be expected.

(7) The powerful psychological support provided by a primary combat group (squad, platoon, or company) is perhaps the single most important factor helping to sustain a

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soldier in the face of severe combat stress. The importance of the group is likely to assume even greater significance during nuclear combat, a factor that has implications for the rotation of troops into and out of combat as well as for training, organization, and management of personnel.

(8) In general, it seems likely that soldiers would sustain the stresses of nuclear warfare better than would civilians. Since a soldier would have been trained for survival under conditions of nuclear warfare, he would probably have a somewhat better understanding of it, and be somewhat less vulnerable to its stresses. Also, the soldier's primary group could be expected to provide strong psychological support which would help sustain him under the stress of nuclear combat. Finally, a soldier would generally be able to take some form of direct action—however small it might be—against the threat, and action reduces stress and is of positive psychological value. The soldier is not as helpless as the civilian, and is less likely than a civilian to perceive himself as helpless in the face of nuclear warfare.

(9) In nuclear warfare it is likely that, in general, social control would not break down and civilian populations would not engage in amoral, lawless, and asocial behavior. The chief problem for nuclear warfare would seem to be less whether people would respond to authority than whether authority structures would exist to which they could respond.

(10) The way in which a soldier would act on the nuclear battlefield is likely to depend to a very large extent upon his training, the type and form of information that he had received and retained, and the nature of his beliefs about nuclear combat. Comprehensive and systematic training, carefully constructed and administered, is currently needed in order (a) to provide the soldier with the skills and knowledge that he would need in order to fight and survive in a nuclear environment, and (b) to prepare him, insofar as possible, to cope under the extreme stress of nuclear combat. For full effectiveness, preparation for combat stress and training for specific combat skills and knowledge would need to be conducted simultaneously.

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## **Human Factors in Tactical Nuclear Combat**

## INTRODUCTION

World events in the atomic age and the possibility of nuclear and thermonuclear conflict have forced the revision of pre-atomic strategic and tactical concepts of warfare. Among the many questions that have been raised are those concerned with the probable behavior of men on the nuclear battlefield.

The magnitude of physical injury resulting from blast and from thermal and nuclear radiation can be reasonably estimated, but little is known about the probable response of man to the stress of nuclear battle. Some way of estimating the psychological effects of nuclear warfare on military personnel is essential to provide a basis for planning military action and training for operation under such conditions. Lacking direct information, such an estimate must be based primarily on data and observations from conventional combat, civilian disasters, and other extreme stress situations.

The purposes of this research are to:

- (1) Draw together and analyze such information.
- (2) Indicate characteristic conditions that give rise to behavioral deterioration under stress.
- (3) Isolate those stress-producing factors likely to be particularly significant in nuclear combat.
- (4) Provide estimates of probable behavior of soldier and civilian groups in nuclear war.
- (5) Discuss methods of preparation and factors affecting man's capacity for coping under the extreme stress of nuclear combat.
- (6) Develop and provide a means for estimating the extent of the psychological casualties that could be expected to occur as a result of participating in tactical nuclear battles of differing character and intensity for varying periods of time.

Part I of the report is an analysis of man's behavior in response to extreme stress. Selected aspects of characteristic behavior observed in both civilian and military stress situations are reviewed, psychological mechanisms involved in coping with stress are described, and factors of importance in preparing men to face the stresses of the nuclear battlefield are discussed.

Part II deals with the development of a method for predicting the extent of psychological casualties that can be expected as a consequence of tactical nuclear battles.

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## Part I

### MAN'S RESPONSE TO EXTREME STRESS

Information about human reactions in the face of severe environmental stress is to be found in observations of the behavior and adjustment mechanisms of persons, both civilian and military, during war and during other forms of crisis and disaster.

In the early sections of Part I, the behavior of civilian populations during and after the atomic-bomb drops at Hiroshima and Nagasaki and during conventional air warfare is described. Findings from studies of other types of catastrophes are also reported, but attention is focused on behavior during war situations, because of the intensity and continuing nature of the threat involved. Although civil disasters may involve stress as great as that experienced during war, such situations usually develop without prior warning and are not repeated. (As will be shown later, such factors affect a person's response to stress to a considerable degree.) A treatment of the problem of panic is also included.

In later sections of Part I, various stages of the combat effectiveness of military personnel are described. This description includes an analysis of psychological disorders arising in combat, time of appearance, and degree of permanence, and a discussion of the many factors that condition the form of the disorder and its rate of occurrence. Some of these factors are the intensity and duration of stress; nature of the tactical situation; training, preparation, and degree of warning; previous battle history; expectancies regarding the consequences of battle and possibilities of relief and rotation; cultural values; group supports and relations; extent to which breakdown provides secondary gain; and acceptance by combat group of behavior or symptoms as reason for removal from battle.

The final sections of Part I are devoted to the psychological and behavioral consequences of the anticipation of threat; mechanisms involved in coping with severe stress; and various considerations associated with preparation, training, and communication preceding and during stress.

#### HUMAN BEHAVIOR UNDER CONDITIONS OF STRESS

##### Reactions at Hiroshima and Nagasaki

It is obvious that caution must be exercised in applying generalizations based on the behavior of Japanese at Hiroshima and Nagasaki

to future situations involving the tactical military use of nuclear weapons. This is so for at least the following reasons:

- (1) Future groups would have expectations and conceptions about nuclear weapons that the Japanese did not have.
- (2) Cultural differences between the Japanese and Americans or groups of other origin might result in different reactions.
- (3) The bombing of Hiroshima and Nagasaki involved civilian populations; behavior of a military population might differ.
- (4) The yields, manner of employment, and physical effects of future weapons are likely to differ.
- (5) Some degree of preparation for, or defense against, nuclear weapons would be the rule. In Japan, only defensive measures for conventional air warfare existed.
- (6) Japanese responses occurred in a situation in which the nation had been at war for some time prior to the attack. Reactions might differ in other situations, in which the target populations had had greater or lesser amounts of exposure to war stress.

A description of behavior at Hiroshima and Nagasaki is nevertheless quite worthwhile, for it represents the only empirical evidence available regarding the psychological impact of wartime atomic disaster. At the very least, such information is relevant in providing a picture of behavior in a catastrophic situation involving unprecedented casualty rates.

Drawing heavily on the one systematic study of survivors of Hiroshima and Nagasaki, conducted by the Morale Division of the United States Strategic Bombing Survey, and on the case histories reported in John Hersey's Hiroshima, Janis (39) has provided what is perhaps the most careful analysis of reactions during the atomic bombing of Japan. The following summary is based almost entirely on his study.

The people of Hiroshima and Nagasaki were caught without warning and were generally unprepared for the attack. Almost all survivors were personally exposed to physical danger and were aware of the direct threat to their own survival, although there was no realization of the extent of the disaster until evacuation began. The incidence of narrow-escape or "near-miss" experiences was extremely high.<sup>1</sup>

The three principal events reported by the majority of survivors of Hiroshima and Nagasaki were flash and blast effects of the explosion and the presence of large numbers of casualties. Acute fear was the primary response of survivors following impact. Blast effects were seemingly the immediate stimulus evoking excitement or emotional responses, whereas the perception of large numbers of burned, cut,

<sup>1</sup>The so-called "near-miss" phenomenon is particularly relevant in attempting to anticipate the psychological consequences of nuclear warfare. Studies of wartime and peacetime disasters (see following section) indicate that experiences involving a narrow escape from danger give rise to acute and persistent anxiety reactions. Presumably such experiences tend to disrupt those psychological defenses that formerly served to control such emotional responses. If nuclear warfare results in an increase in the number of persons experiencing "near-misses," it would seem reasonable on the basis of this factor alone to expect an increase in the incidence of emotional disturbance.

and maimed bodies was largely responsible for producing emotional trauma. (Janis indicates that the traumatic effects resulting from the atomic blast itself did not seem to differ from those observed in British, Germans, and Japanese who had been exposed to severe conventional air attack.) Although a few terrified survivors behaved in an impulsive or disorganized manner for a short time, there is little to indicate that overt panic or antisocial behavior occurred on any mass scale during either the Hiroshima or the Nagasaki disaster.

Fear reactions persisted among a sizable proportion of the population for many days following the disasters, but the incidence of neurotic responses and severe types of psychiatric disorders, such as depression and apathy, was small. Tentative conclusions drawn by Janis on the basis of the U.S. Strategic Bombing Survey Medical Division's report support generalizations from other types of wartime disaster, such as those advanced by Kalinowsky (46). It seems likely that the transient emotional disturbances immediately following the attacks were the predominant psychiatric effects of these disasters.

While attitudes and morale did change as a result of the atomic bombings, findings of the U.S. Strategic Bombing Survey indicate that morale effects were no different from those produced by heavy conventional air attack. The morale of those persons in and around the target cities did not fall below that of the rest of the Japanese population. In fact, Janis reports that less defeatism existed in Hiroshima and Nagasaki than in other cities, a finding he explains by the fact that morale had been higher than average in these cities prior to the bombing. The decrease in morale after the bombing was no greater than that to be expected from a single heavy air attack of the type then being conducted in B-29 campaigns against other Japanese cities.

#### Responses to Aerial Bombing and Other Disaster Situations

Observations of individuals in various disaster and traumatic situations indicate that many factors operate to affect the specific kinds of behavior that result. Reactions to objective danger differ according to such factors as type of preparatory information available; expectancies and knowledge about the threat; type of prior training, preparatory action, and other anticipatory behavior; characteristics of persons or groups involved; extent of prior exposure to threat; and physical magnitude of threat. Such situational variations affect types of adaptive and nonadaptive behavior elicited, type and duration of emotional response, incidence of psychiatric disturbance, extent of social disorganization, and changes in attitude and morale.

How knowledge, training, preparatory action, and other anticipatory behavior can condition responses to extreme threat will be discussed later. In this section the behavior of civilians during conventional aerial bombing in World War II and in other situations involving disaster or extreme stress is discussed in terms of the relationship between specific patterns of behavior and magnitude and duration of threat, extent of personal involvement, characteristics of target group, and other conditions of the stress situation.

### Prevalence of Psychological Disorders

Heavy air attacks of civilians characteristically bring an increase in temporary emotional shock involving anxiety states, reactive depression, or apathy (21, 39, 40). However, one of the most consistent observations reported is the relative absence of chronic disorders in such situations (34, 39, 46, 83). There is even some evidence that psychiatric problems occasionally decrease during wartime. Citing Titmuss' analysis of wartime psychiatric admission rates in Britain, Janis (39) states that most indications of mental disorder, such as attempted suicides, showed a decrease rather than an increase. Reports dealing with Russian, German, and British civilian groups, cited by Kalinowsky (46), suggest an inverse relationship between degree of involvement in the war and incidence of psychiatric problems.

Following a systematic review of available evidence, Janis (39)<sup>1</sup> concludes that "air attacks of the type employed against civilian communities in World War II produced only a slight increase in chronic psychopathological disorders." He mentions that even those authorities who are most critical of the evidence of wartime psychiatric casualty rates tend to agree with this conclusion.

While care must be exercised in drawing conclusions from the existing literature regarding psychological health during war, one is nevertheless struck by the varied reports indicating man's seemingly remarkable recuperative powers and tolerance of stress in situations involving the severest forms of trauma. Thus Galbraith in The Affluent Society (22) describes happenings during and after the bombing of Hamburg.

On three nights late in July and at the beginning of August, 1943, the heavy planes of the RAF Bomber Command droned in from the North Sea and subjected the city of Hamburg to an ordeal such as Germans had not experienced since the Thirty Years' War. A third of the city was reduced to a waste land. At least 60,000 and perhaps as many as 100,000 people were killed—about as many as at Hiroshima. A large number of these were lost one night when a ghastly "fire storm" which literally burned the asphalt pavements, swept a part of the city and swept everything into itself. Adolph Hitler heard the details of the attack and for the only known time during the war, said it might be necessary to sue for peace. . . . In the days immediately following the raids production faltered. In the first weeks it was down by as much as 20 or 25 percent, but thereafter it returned to normal. By then the workers had scanned the ruins of their former homes, satisfied themselves that their possessions and sometimes their families were irretrievable, had found some rude clothes, and the shelter of a room or part of a room in a still habitable house and had returned to work. On these three nights of terror, their standard of living measured by house room, furnishings, clothing, food and drink, recreation, schools, and social and cultural opportunities had been reduced to a fraction of what it had been before. But the efficiency of the worker as a worker was unimpaired by this loss. After a slight period of readjustment he labored as diligently and as skillfully as before. (pp. 161, 162)

<sup>1</sup>See Janis for additional references on this topic.

In cities such as Nuremberg and Freiburg, which were among the most heavily damaged in Germany, Kalinowsky (46) reports that the number of neurotic reactions between 1942 and 1945 was lower than in peacetime (in Freiburg, it was half the usual number). One cannot conclude either that the incidence of psychological difficulties in such situations was low or that the reported occurrence of such responses adequately reflects the actual occurrence. In fact, neurotic symptoms and other strong emotional responses undoubtedly did occur and perhaps were almost universal. What can be concluded, however, is that in most cases such responses apparently either were largely transient, involving fairly rapid recovery and permitting early return to work, or were of such a nature that they did not require professional medical treatment.

#### Nature of Responses

The "normal" responses of fear and terror, as well as those transitory disturbances of a more severe nature that appear when persons are exposed to aerial bombardment, earthquakes, automobile accidents, and other forms of disaster, have been described by Janis (39). Severe reactions involve various forms of mild or acute sensory and motor disturbance, emotional agitation, and irritability. Symptoms range from mild trembling, stammering, and crying spells to more acute anxiety attacks involving severe startle reactions, sensitivity to noise, tremor, tachycardia, nightmares, and conversion symptoms. Instead of agitated anxiety reactions, traumatic responses frequently involve mild or acute forms of depression, apathy, stupor, and mental inhibition. While the more severe reactions may lead to temporary incapacitation, full recovery from such states of shock, either spontaneously or in response to rest and simple treatment, is likely—generally within a period of hours or days, or sometimes weeks.

By far the most characteristic responses in such situations, however, are fear reactions that result in little or no incapacitation. During air raids fear responses are widespread and vary in intensity from mild to severe, with the usual reactions being acute. Few persons claim not to have been frightened at all. In general, behavior is well controlled despite feelings of intense fear. Janis (39) indicates that:

... this "normal reaction" ... was characterized by a high degree of *appropriateness to the danger situation*. Usually the symptoms were elicited only by signs of immediate danger, such as the sound of bombs exploding. Although the warning signal of planes overhead frequently evoked apprehensions, the somatic symptoms of fear usually did not build up if there was merely a "quiet" alert. Whenever a dangerous raid occurred, however, acute symptoms developed and persisted throughout the period of danger, generally subsiding within one-quarter of an hour after the end of the bombing attack.  
(pp. 98, 99)

In any particular air attack, intensity of emotional response appears to be directly related to intensity of threat. Fear reactions tend to become more severe and widespread as the physical magnitude of the raid increases, and incapacitating anxiety and depressive reactions

tend to increase. In general, with continued intermittent exposure to potential harm in light or even heavy air attacks, a form of emotional adaptation sets in and anticipatory fears as well as emotional responses during the raid itself tend to diminish. For persons who have had personal contact with an extremely stressful situation, however, the capacity for adaptation is reduced and emotional responses are likely to increase rather than decrease with subsequent exposures to stress.

The special sensitizing effects of direct involvement in a traumatic event—as contrasted with the rather different consequences of experiences in which warning signs or danger cues are perceived but not accompanied by direct dangerous impact—have been referred to by MacCurdy (51) as “near-miss” as contrasted with “remote-miss” experiences.<sup>1</sup> Studies of peacetime disasters and clinical observations in World War II indicate that acute emotional shock, traumatic neuroses, and severe and prolonged fear reactions are most likely to occur among persons who are directly or personally involved, that is, those who narrowly escape death, witness destruction or death of persons nearby, or lose loved ones.<sup>2</sup> “Near-miss” experiences, because of their fear-reinforcing properties, result in states of apprehension, hypervigilance, and prolonged fear reactions. Thus they are likely to be associated with some degree of continuing stress even after objective danger ceases.

Persons involved in “remote-miss” situations also experience fear and tension upon perceiving warning signs, such as the sound of air-raid sirens or bombs exploding elsewhere; however, once the danger situation has ended, their previous fears tend to be replaced by feelings of optimism and confidence. These are the persons likely to undergo a form of emotional adaptation following a series of such experiences. Thus overt fear responses declined and reactions of indifference to danger appeared among persons in Britain who had been extremely vigilant during the first raids of the war, even though the raids later became heavier and more destructive. Janis (39) states:

From the various sources of evidence it seems fairly safe to conclude that a sizeable proportion of the civilian population exposed to successive air attacks during World War II displayed a gradual decline in fear reactions. . . . [however, one must take] into account other reaction tendencies that are also evoked by recurrent danger experiences—tendencies which would operate in the direction of counteracting or preventing the development of emotional adaptation. . . . Obviously, when a population is exposed to recurrent danger, widespread manifestations of emotional adaptation can be expected *only if there is a relatively low incidence of near miss experiences.* (pp. 113, 116)

The fact that emotional adaptation does not occur when persons have experienced a series of narrow escapes is especially significant with respect to the behavior of soldiers in combat. As will be

<sup>1</sup>See Fraser, Leslie, and Phelps, 19; Glover, 34; Grinker and Spiegel, 36; Janis, 39, 42; MacCurdy, 51; Moore, 59; Wolfenstein, 85.

<sup>2</sup>See footnote on p. 5.

indicated in a later section, in battle, where some direct exposure to extreme threat is likely, tension and anxiety increase rather than decrease over time. In ground and aerial warfare, duration of exposure to stress is probably the single best predictor of combat exhaustion.

#### Effects of Group Membership

In addition to a description of emotional responses of individuals, observations of civilians in World War II and other disaster situations also provide some information on the effects of disaster and stress on morale and other aspects of group behavior. Janis (39) reports that the greatest deterioration in morale occurred among those who had been exposed to the heaviest bombing. Decrements in morale, however, were not proportional to the physical magnitude of the attack, since incidence of serious personal involvement (e.g., personal injury, casualties in the immediate family, destruction of home and property) does not increase proportionately to intensity of attack.

Summarizing a series of papers analyzing behavior exhibited in various natural and civil disasters, Demerath (15) concludes that group solidarity increases and that morale is higher immediately following disaster than it is subsequently. The organized response of the group in a disaster situation is more effective where previous group solidarity was high, plans of action had been rehearsed, and roles were well defined. This observation is consistent with others (64) indicating the superiority of organized and professional groups both in coping with disaster and in resisting disorganization under conditions of stress.

There is considerable agreement in the literature that human beings under threat of disaster are not motivated solely by concern for their own physical safety (14, 39, 63) but rather tend to direct their loyalties and attention to the needs of small primary groups to which they belong. Group membership is an important factor affecting both a person's responses in a disaster situation and, as will be indicated later, his resistance to the effects of stress.

#### Reactions to Authority

In disaster situations persons do not usually reject authority or fail to follow leadership. Rather, they frequently exhibit an unusual reluctance to act independently (40). This occurs whether or not they are suffering from apathy or depression. Lack of independence sometimes appears as a tendency to become passive followers or to cling to authoritative persons. Responses include a docile waiting for orders, an active seeking of direction from others, and instantaneous obedience to leaders.

Persons in this state of mind occasionally will blindly follow a directive that is inappropriate or mistaken. Thus, an important consequence of this kind of dependency is that errors in leadership are not likely to be discovered or corrected rapidly.

In their discussion of responses to authority in disaster situations, Nordlie and Popper (63) conclude:

... it appears justifiable to say that on the basis of past experience with people's response to authority under emergency conditions, on the whole, affected populations have displayed more compliant and submissive behavior toward authority than they have aggressive hostility. There are almost no grounds for the opinion that social control mechanisms break down in disaster situations and people indulge in amoral, lawless, and asocial behavior. To the contrary, the opposite appears to occur. The chief problem appears to be not whether people would respond to authority, but rather the extent to which authority structures exist to which they could respond. (p. 59)

### Panic

Perhaps the most stereotyped concern or belief expressed by officials and other persons attempting to anticipate the behavior of both civilian and military personnel in the event of nuclear conflict is that panic and other forms of mass hysteria would occur. Conceivably, the character and the greater personal danger of nuclear battle could lead to some increase in the incidence of panic. It is desirable, therefore, to consider what is known about panic as a form of individual and group behavior, its characteristics, and its likelihood. It is also desirable, insofar as it is possible, to identify the conditions that give rise to panic and to direct attention to specific factors likely to be crucial in affecting the probability of its occurrence in nuclear conflict.

#### The Nature of Panic

Hearsay and "popular" writing on disaster emphasize panic so heavily that one gains the impression it is both the most important and the most common type of disaster behavior. This is not true; panic is, in fact, quite uncommon. It is unfortunate that the literature dealing with panic is, with few exceptions, nonempirical, consisting for the most part of unsystematic treatments based on anecdotal evidence supplied by participants or onlookers of supposed panics.

In Quarantelli's systematic and scholarly discussion of panic (65), the generally confused treatment the topic has received is emphasized by indicating the lack of agreement regarding even what falls within the meaning of the term:

Almost every kind of socially disorganizing or personally disrupting type of activity has been characterized as panic. The range includes everything from psychiatric phenomena to economic phenomena (e.g., the "panics" involved in bank runs, stock-market crashes, depressions, etc.). Thus, in one recent book there are cited as instances of panic such phenomena as lynching mobs, suicidal epidemics, individual and collective anxieties, plundering troops, spy hysterias, military retreats and surrenders, social unrest, war, psychotic behavior, mass hysterias, animal stampedes, confused voting behavior, orgiastic feasts, the activities of war refugees, and group tensions. (p. 268)

Strauss (75) has tabulated the opinions of 17 authors (primarily military) with regard both to factors that cause panic and to methods of prophylaxis. Comparison of the positions of these writers illustrates the diversity of opinion and emphasis that exists.

The conditions usually listed as giving rise to panic fall roughly, according to Strauss, into three general categories:

- (1) Physiological—fatigue, exhaustion, undernourishment, lack of sleep, intoxication, and other toxic conditions of the body.
- (2) Psychological—surprise, uncertainty, insecurity, anxiety, emotional tension, hallucination, feelings of isolation and helplessness before the inevitable, and expectancy of danger.
- (3) Sociological—lack of group solidarity, crowd conditions (including suggestion, imitation, and contagion), lack of leadership, or breakdown of faith in the leader.

Both Quarantelli and Strauss point out the explanatory inadequacies of such listings, in which comparable levels of analysis are not maintained and in which all factors are treated as if interchangeable. Both writers have noted, as an additional obstacle to understanding panic, that many conditions which are said to lead to panic do not always have this result, but may elicit other reactions. Strauss writes:

Furthermore, the conditions of panic which have been noted, because they are not genuine causative conditions, are conditions for more than just panic. That is to say, the conditions for panic which are listed in the literature are not conditions for panic specifically; they are also conditions for other kinds of closely related collective phenomena. Falling into freezing water is a condition for catching a cold, diphtheria, headache, pneumonia, and a dozen other ills. Similarly with the listed panic conditions. Panic is a species of a genus which includes such collective nonrational phenomena as collective hysteria, collective fanaticism, collective exaltation, collective heroism, and the like. Many of the conditions of panic which have been listed in the literature are also for the most part conditions for these latter phenomena. The role played in the occurrence of these phenomena by suggestion, illusion, heightened imagination, collective contagion, fatigue, undernourishment, crowd excitement, loss of self-control, anxiety, emotional tension, and so forth, is well known. The thin line between the occurrence of panic and the occurrence of these other forms of collective nonrational behavior is attested to by the rapid shifts from one of these forms to another in battle—from collective exaltation to panic, from panic to collective fanaticism, and the like. (pp. 324-325)

It is possible to impose some order on this seeming mass of confusion by considering an important distinction made by Foreman (18), who suggested that the psychological and sociological writing on panic is concerned with two somewhat different conceptions. In the first, the term panic refers primarily to the feelings or behavior of a terrified individual—one who is in a state of intense fear or anxiety. Here panic is conceived as a state of terror. In the second conception, panic is thought of as a type of rout or flight; it may manifest itself in disaster situations as actual physical running.

Once a distinction is made between panic as terror and panic as flight, some of the seemingly contradictory statements in the literature can be explained. Where one of the defining properties of panic is the absence of apparent routes of escape (Janis, 39; Demerath, 15), it would seem that panic is being thought of primarily as terror. But where one of the defining properties of panic is the belief in the presence of temporary routes of escape (Chapman, 14; Fritz and Marks, 21; Quarantelli, 65; Williams, 84), it would seem that panic is being thought of primarily as flight.

Since there is nothing novel about the appearance of intense fear and anxiety reactions per se in response to a wide variety of traumatic and disaster situations, and since such reactions are discussed elsewhere in this report, the remainder of this section is devoted to a discussion of panic conceived of primarily in terms of flight or physical escape. Panic, then, as characterized by Quarantelli (65), is:

... an acute fear reaction marked by a loss of self-control which is followed by nonsocial and nonrational flight behavior. Covertly there is an acute fear reaction, i.e., an intense impulse to run from an impending danger. Panic participants are seized by fear of a specific object defined as involving an immediate and extreme physical threat. The most striking overt feature is flight behavior which, while not necessarily non-functional or maladaptive, always involves an attempt to remove one's self physically. Thus panic is marked by loss of self control, that is, by unchecked fear, being expressed in flight. Two other prominent features are nonrational thought and nonsocial behavior: panic participants do not weigh the social consequences of their flight and are highly individualistic and self-centered in their actions with reference to one another. There is no consideration of alternative courses of action to flight. Thought being focused on the removal of one's self from danger, the ordinary social norms and interactional patterns are ignored and there is no possibility of group action. (p. 272)

#### Conditions Under Which Panic May Occur

Panic as flight occurs only when danger is perceived as involving an immediate and direct bodily threat, and the situation is perceived as one in which escape is possible at the moment but may become impossible in the immediate future. The crucial aspect is the joint condition of entrapment and decreasing avenues of escape. As Quarantelli indicates, however:

The feeling of possibly being trapped does not necessarily (although this is most frequently the case) involve actual physical obstacles to movement. War refugees caught in the open by strafing planes can develop as acute a sense of potential entrapment as individuals inside a building during an earthquake who see all exits becoming blocked by falling debris. (p. 24)

Another condition mentioned by Quarantelli as necessary but not unique to the occurrence of flight in panic is a feeling of helplessness that typically manifests itself in two components: inability to affect or control the threat, and a sense of "aloneness." A person may feel, often quite correctly, that he is unable to prevent the consequences of impending danger. Although he feels powerless to bring

the threat under control, he does not despair of escaping danger by fleeing, but he feels that he must act alone in his search for a way to safety. Quarantelli indicates that in all instances of panic-flight the feeling of "aloneness" or dependency on one's own action is present to some degree.

When panic does occur it tends to be short-lived, lasting only until there has been escape from the immediate source of danger.

As suggested earlier, the accumulated data on the reactions of persons involved in aerial bombing and other forms of disaster indicate that behavior in such situations is surprisingly rational and adaptive. Researchers studying this problem have leaned heavily on material such as the disaster studies of the National Opinion Research Center, which were based on interviews of nearly 1,000 persons involved in more than 70 different major and minor disasters such as tornadoes, earthquakes, floods, coal-mine and plant explosions, industrial fires, building collapses, train wrecks, and airplane crashes in residential areas. Researchers agree that panic is a relatively unusual phenomenon arising under exceptional conditions.<sup>1</sup>

Controlled withdrawal is actually much more common than panic-flight. This kind of behavior is not merely escape from danger, but rather movement toward a goal. As Fritz (20) has stated:

In general, the goal-oriented forms of behavior are much more common than the uncontrolled, non-rational types, even on the part of persons who are in the epicenter of a disaster. Persons on the periphery or outside the impact area most frequently engage in anxiety motivated behaviors —e.g., attempting to locate, rescue, or retrieve intimates or other cherished objects in the impact area. It is not the irrationality or maladaptiveness of individual behavior that raises logistic and control problems in disasters; rather it is the lack of coordination among the large numbers of actors who are acting on the basis of relatively private definitions. This is why the reestablishment of the channels of communication becomes so crucial in disasters. In order to restore concerted behavior, it is necessary to substitute a common or collective definition for the multitude of private definitions. (p. 8)

#### Panic in Military Situations

The applicability of Fritz's comments to the conduct of tactical operations during combat is obvious. The particular significance of maintaining adequate communications and its relation to behavior under stress in the tactical nuclear situation will be discussed in a later section.

In regard to the problem of panic in military situations in general, Quarantelli (65) states:

In so far as any statement can be made on the basis of the scanty reliable data, it would seem that military panics are the same in nature and development as panic in general. Consideration of the data suggests however, the necessity of one precondition for the emergence of military panic. Normally,

<sup>1</sup>Chapman, 14; Foreman, 18; Fritz, 20; Fritz and Marks, 21; Janis, 39; Janis *et al.*, 44; Quarantelli, 65; Williams, 84.

military groups function collectively and effectively as a matter of routine in the face of very extreme personal dangers. Only where there is an absence or breakdown of this normal military group solidarity is panic possible. (p. 273)

Since panic-flight occurs only where a physical threat is accompanied by the dual belief of possible entrapment and escape, one point should be emphasized in trying to estimate the likelihood of panic occurring on the tactical nuclear battlefield. Perhaps here, as never before, and regardless of whether or not it is true, the individual soldier would be more likely to perceive the situation as one in which his chances of survival are minimal and to assume that there is almost nothing he can do to prevent or affect direct bodily threat or entrapment. Since soldiers cannot prevent the disaster from occurring, some may believe that they can remove themselves from it by running away. Thus there exists the possibility of an increased likelihood of those conditions necessary for panic.

It is not clear to what extent soldiers would believe that running would bring escape or reduction of nuclear threat. Some might see flight as having no effect on their chances of escape; others might see running as favoring escape, since such action would separate them physically from their units, which they believe either to represent targets or to be in danger otherwise; still others might believe that running would increase their chances of becoming a casualty, since running would preclude the safety of a foxhole or other type of cover.

Thus the information possessed by soldiers regarding the characteristics and threat of nuclear battle, and particularly their actual beliefs with respect to the likelihood of bodily harm or the possibility of escape by running, could readily become critical factors affecting their behavior. Since attitudes and beliefs can be modified by training and indoctrination, the particular nature of information and training that a soldier receives prior to nuclear combat is likely to be extremely important—not only in affecting the likelihood of panic but, more critically, in determining his over-all behavior in battle.

In any event, it seems likely that panic-flight will remain very uncommon. While the greater threat of nuclear battle may lead to an increase in occurrence of those conditions necessary for panic, it is unlikely that there will be any substantial increase in its actual happening. As indicated above, men in combat have always operated under conditions of extreme threat, sometimes where death was likely or even inevitable. Panic has nevertheless been extremely rare. There is no evidence to suggest that it will not remain so.

#### Behavior of Military Personnel in Combat

##### Introduction

A description of the reactions of soldiers to the stress of combat needs to cover a wide range of behavior. Depending upon the intensity and duration of battle, as well as upon specific situational conditions, many different types of behavior can be observed. They

may involve effective combat performance or some degree of combat failure, but they all represent attempts to cope with the severe stress of battle. Even psychological breakdown in combat, though it is a maladaptive adjustment, represents a form of coping behavior in that it provides escape from intolerable reality.

This section contains a general description of the various phases of man's response to stress in combat and its relation to combat effectiveness. Included is a discussion of some of the many factors which influence a man's behavior in battle by affecting the defensive processes and coping mechanisms that sustain him in the face of severe stress. If he remains in combat long enough, such factors also condition the rate of his deterioration and ultimate collapse. These factors affect levels of stress, resistance to stress, and the particular form in which psychological casualties find expression. Attention will be directed to behaviors ranging from mild emotional responses and transient states of shock, anxiety, and depression, to the more severe and lasting conditions of combat exhaustion which make it necessary to remove a man from battle, temporarily or permanently.

The discussion is concerned primarily with matters that are clearly psychiatric in nature, such as characteristics of emotional disorders, and factors affecting neuropsychiatric casualty rates. Only passing consideration will be given to types of behavior, involving various forms of combat failure, that are not ordinarily classified as neuropsychiatric although they do represent psychological problems and are clearly related to matters that are obviously psychiatric. These behaviors include: (1) passive participation in battle, shown in lack of contribution to fire power, straggling, or disappearing; (2) disciplinary offenses such as desertion, insubordination, and refusal to obey orders; (3) self-inflicted wounds and other nonbattle or "accidental" injuries; (4) loss of personal (eyeglasses, dentures) or other equipment that may, at least temporarily, serve to remove a person from combat; (5) malingering, such as complaints of minor somatic or subjective disorders that are not incapacitating (e.g., headache or backache) or not accompanied by evidence of physical disability.

As will be discussed later, various writers (5, 17, 28, 33, 66) have indicated both the relationship and the interchangeable nature of NP disorders and other types of nonbattle casualties. While the following discussion is restricted largely to the more acute psychological effects induced by combat stress, it should be noted that other types of nonbattle casualties and battle failure arise in similar situations.

#### Phases of Combat Effectiveness

For descriptive purposes it is convenient to think of the combat effectiveness of a soldier roughly in two phases: a period of increasing effectiveness and a period of decreasing effectiveness. Upon entry into combat a man is usually not very effective. As he adapts to the conditions of battle and becomes "battle-wise" (i.e., becomes familiar with the sounds of his own and the enemy's weapons, learns the caliber and closeness of fire and the use of cover and concealment,

learns to discriminate and select appropriate targets, etc.), his effectiveness increases until at some point he reaches his peak. A period of decreasing effectiveness then ensues.

The individual variation in this sequence is wide (16<sup>1</sup>, 82). For example, the performance of many men shows little improvement in combat; others quickly become noneffective because they are stricken with severe psychological disorders immediately upon or even before entering combat.

Several different processes are associated with this sequence. Low effectiveness in soldiers early in combat can be attributed both to an initial lack of knowledge and proficiency in the many subtle techniques and discriminations that are required in battle, and to the inhibitory and disruptive effects of the sharp rise in fear and anxiety that occurs upon entry into combat. This increase in fear and anxiety is a consequence of the intense threat and trauma of battle, the newness and relatively unknown character of the experience itself, and the fact that men who are new in battle are generally uncertain of their ability to defend themselves and survive.

Generally, a soldier's effectiveness tends to improve from its initially low level as he adapts, through experience, to the conditions of combat. It has also been shown that with increasing time in combat the likelihood that a man will become a battle casualty decreases progressively (Beebe and Appel, 4). It is likely that all of the following explanations have some basis in fact and are relevant to this phenomenon:

- (1) Those men who are least able to protect themselves are eliminated early in combat, or at a more rapid rate than the average soldier.
- (2) With increasing combat experience, most men learn to protect themselves more adequately while increasing or maintaining their combat effectiveness (for at least some period of time).
- (3) With increasing time in combat some men tend to protect themselves at the expense of adequate combat performance (i.e., keep themselves hidden, hang back, or become passive participants). This contributes directly to decreasing combat effectiveness.

While battle casualties tend to decrease as a function of combat experience, there is universal agreement that nonbattle casualties in general, and psychological disorders and NP casualties specifically, show a progressive increase as a function of time in combat.<sup>2</sup> As will be noted in the following section, the increasing incidence of psychiatric disorders and the corresponding loss of combat effectiveness are

<sup>1</sup>HumRRO Special Report 13 describes a study conducted in Korea in which various forms of effective and ineffective combat behavior were identified and related to background and other variables.

<sup>2</sup>See 1, 3, 23, 29, 32, 33, 36, 38, 39, 76, 77, 79 (October 1943), 81.

due primarily to the cumulative effects of the stress of combat through continued exposure to battle.<sup>1</sup>

#### Effects of Current and Cumulative Stress

Combat stress is the single most important cause of psychological disorders among troops during warfare. As early as World War I,<sup>2</sup> it was recognized that men break down in direct relation to the intensity and the duration of their exposure to combat. The later recognition that "shell shock" was not the result of cerebral concussion, but rather was a name given to psychological disorders arising as a function of the stress and trauma of combat was anticipated by Smith and Pear (71), writing in 1917. They indicated that the shell explosion which presumably was related to such disorders was only the final precipitating cause, since patients had previously exhibited all of their symptoms of psychological disorder, at least to some extent. Smith and Pear wrote that "one of the greatest sources of breakdown under such conditions is intense and frequently repeated emotion" (p. 6). Psychiatric disintegration may follow the intense current stress of a single battle, or it may result from the prolonged, cumulative stress of continued exposure to combat.

Current Stress. As many writers have stated,<sup>3</sup> after study of experiences in World War II and Korea, there can be no doubt that battle intensity or situational and current stress is directly related to the incidence of psychological disorders and psychiatric disorders and casualties.

The development of combat exhaustion<sup>4</sup> in men in units having below-average, average, and above-average battle casualty rates has been described by Swank (76) and Swank and Marchand (77), who showed that men in units with extremely high casualty rates broke down earlier and showed more acute symptoms. Men in units with below-average casualty rates showed fewer cases of breakdown, and these developed after a longer period of time. The early Tunisian Campaign, in which U.S. troops faced overwhelming air superiority and sustained heavy casualties, was particularly traumatic and produced unusually large numbers of psychiatric casualties, as reported by Grinker and Spiegel (35).

Glass (24) has indicated that combat soldiers, in general, managed fairly well until the intensity and trauma of battle increased as, for example, when close shell hits—"near-misses"—were encountered. Garner (23) has also mentioned how short but extremely intense or terrifying experiences, such as crouching in a foxhole a few feet away

<sup>1</sup>Beebe and Appel (4) have confirmed these observations in a careful actuarial study. Information developed by them was used in the development of the model (see Part II) for predicting NP casualties as a function of combat intensity and time in combat. Their study is described on p. 21.

<sup>2</sup>Appel and Beebe (1); Garner (23); Glass (33); Surgeon General's Office (79), October 1943.

<sup>3</sup>1, 23, 29, 38; and 79 (issues of February, September, October, and December, 1944, and February 1953).

<sup>4</sup>The topic of combat exhaustion is treated in the section beginning on p. 22.

from an exploding shell, or being caught in a cellar from which escape is cut off and into which the enemy fires point-blank with tank-borne artillery, could frequently be the immediate cause of acute psychological disturbance.

The most direct evidence regarding the clear relationship between intensity of combat and incidence of psychological disorders is found in a comparison of battle casualty and NP casualty rates. Appendix A contains graphs, based on data obtained from the Office of the Surgeon General, showing NP and wounded in action (WIA) casualty rates by week for 10 Infantry, 6 Armor, and 1 Airborne division in the European Theater of Operations (ETO) during 1944-45. Inspection of the graphs shows clearly that NP casualties rise and fall regularly with battle casualties.

Graphs showing the consistent manner in which NP and WIA admission rates are covariant at theater, army, and division levels have been published by Hanson (38) and Beebe and DeBakey (5)<sup>1</sup>. Brill and Beebe (13) computed correlation coefficients for NP and WIA weekly admission rates for 55 divisions in the ETO in 1944-45. The majority of the correlations lie between +.70 and +.90.

Cumulative Stress. The most important factor affecting the frequency of psychological disorders and the rate at which NP casualties occur is the cumulative stress which is primarily a function of the duration of man's exposure to battle. It has commonly been observed that the longer men are exposed to combat, the greater is the number of acute psychological disorders and psychiatric casualties that result.<sup>2</sup> This fact is attested to by the high incidence of psychological disturbances among veteran combat troops, a condition sometimes referred to as "old sergeants' syndrome."

It is generally recognized among both medical and combat personnel that all persons have a breaking point, and will exhibit symptoms indicating acute psychological disturbances and eventually suffer complete combat exhaustion if they remain in combat long enough. Thus various authors have written:

In the North African Theater neuropsychiatric casualty rates of 1,200 to 1,500 per thousand strength per year (for short periods) were not uncommon in rifle battalions. . . . Of more significance, however, is the fact that in the North African Theater practically all the men in rifle battalions who were not otherwise disabled ultimately became psychiatric casualties. Although only 1 to 3 percent of the combat strength was lost from this cause during any single offensive, apparently the intensity and duration of continued campaigns surpassed the limit of endurance of the average soldier. (Appel and Beebe, 1, p. 1470)

Other factors being equal, it is recognized that individual tolerance for battle stress varies. Combat exhaustion may appear in as few as fifteen or twenty days or in as many as forty to fifty days. . . . One thing alone seems to be certain: practically all infantry soldiers suffer from a neurotic reaction

<sup>1</sup>An exposition of the close association between nonbattle and battle casualty rates during combat as, for example, among various Military Occupational Specialties is presented in Beebe and DeBakey (pp. 43-45).

<sup>2</sup>1, 23, 29, 36, 76, 77; and 79 (issues of October 1943, April and August 1944).

eventually if they are subjected to the stress of modern combat continuously and long enough. (Swank and Marchand, 77, p. 243)

One may learn to adapt better under fearful conditions, but there is no diminution of the painful and paralyzing action of fear as a result of repeated exposure. This fact is responsible for the recognition of rotation as the only method of preventing the inevitable breakdown of veteran combat personnel. (Glass, 29, p. 92)

Apropos of Glass's comments regarding the importance of rotation, it should be noted that the NP morbidity rate during the Korean war was substantially lower than in World War II (79, April 1954). While it seems likely that a variety of factors were responsible, the rotation policy introduced during the Korean war was probably the single most important factor contributing to this difference (28).

Although it has been observed that a unit's nonbattle casualty rate, particularly its NP rate, becomes progressively larger the longer it remains in active combat, it is difficult to establish any precise relationship between duration of combat exposure and incidence of NP casualties. Intensity of combat is the single most significant factor affecting NP rate at any particular time but the rate is also affected by the episodic nature of combat and variations in other factors, such as length of rest periods, type of unit, tactical situation, leader effectiveness, unit cohesiveness, weather, and terrain.

Combat is usually episodic but, where information is available regarding conditions of continuous battle, the cumulative effect of combat stress on numbers of NP casualties is particularly dramatic, as is illustrated in Figure 1. This figure shows the number

#### Neuropsychiatric and Battle Casualties Among Three Infantry Battalions in Sicilian Campaign for 18-Day Combat Period

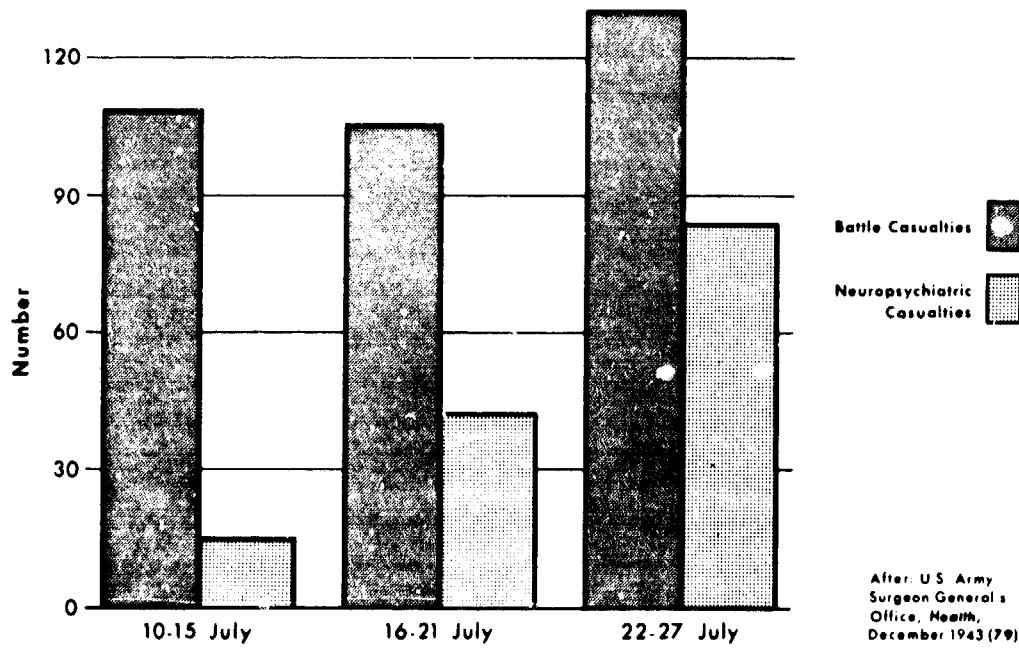


Figure 1

of battle and NP casualties in three battalions during three successive periods of 18 days of continuous combat. It will be noted that the battle casualties are relatively constant during the different intervals, whereas there is an ever-increasing rise in NP casualties.

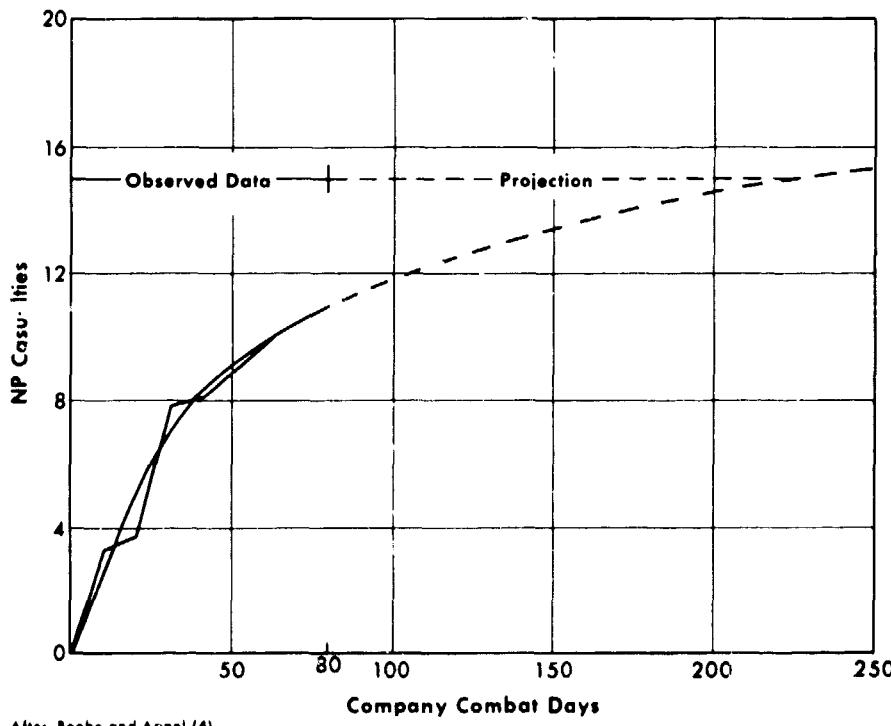
The most precise information that is available on the relationship between duration of combat exposure and NP rate is to be found in the excellent study by Beebe and Appel (4), done for the Department of the Army under the auspices of the Division of Medical Sciences of the National Academy of Sciences. The records of 1,000 men were drawn at random from high-risk MOS's in Infantry divisions in the Mediterranean Theater during 1943-45. Battle casualty rates were used as an index of combat risk, with MOS's in the sample accounting for about 75% of a World War II rifle company. The sample consisted of 530 riflemen, 181 squad leaders, 101 automatic riflemen, 80 ammunition handlers, 65 machine gunners and mortar crewmen, 29 platoon sergeants, and 14 section leaders.

The records of these men were examined to determine the relationship between NP rate and time in combat. Defining a day of combat as any day in which a company containing a member of the sample sustained at least one battle casualty, a determination was made of the number of days of combat that a man had gone through before becoming an NP casualty. Reliable data were obtained for time periods up to 80 days of company combat.

Actuarial procedures were used to establish the rate at which men became NP casualties (see Fig. 2). This was done by

#### Neuropsychiatric Casualties in Relation to Time in Combat

(Per Thousand Men per Day)



After: Beebe and Appel (4)

Figure 2

determining rates of NP attrition from the original data, and then applying these rates to a population of 1,000 men to estimate the probable psychiatric attrition as a consequence of "cumulative combat stress." The resulting NP casualty or departure rates by day and by successive 10-day intervals are indicated in Table 1, along with the numbers of NP departures for each 10-day interval and on a cumulative basis. NP casualties are the only form of attrition shown in Figure 2 and Table 1, which do not reflect the fact that men would leave combat for other reasons. The information in Table 1 beyond combat day 80 is based on a projection of the curve.

#### Combat Exhaustion

Types of Psychiatric Disorders. Army psychiatrists classify neuropsychiatric disorders in terms of the following major diagnostic

Table 1  
**Psychiatric Attrition for a High-Risk Sample  
 as a Result of Cumulative Time in Combat**  
*(Estimated by Life-Table Procedures)<sup>a</sup>*

Company Combat Days	Psychiatric Departure Rate		Exposed Population at Start of Interval	Psychiatric Departures	
	Per Day	Per Interval		Simple	Cumulative
1-10	2.0	19.84	1,000.00	19.84	19.84
11-20	5.0	48.95	980.16	47.98	67.82
21-30	7.0	67.90	932.18	63.30	131.12
31-40	8.2	79.11	868.88	68.74	199.86
41-50	9.1	87.45	800.14	69.97	269.83
51-60	9.3	93.88	730.17	68.55	338.38
61-70	10.4	99.32	661.62	65.71	404.09
71-80	10.9	103.88	595.91	61.90	465.99
81-90	11.3	107.46	534.01	57.38	523.37
91-100	11.7	111.09	476.63	52.95	576.32
101-110	12.1	114.68	423.68	48.59	624.91
111-120	12.4	117.35	375.09	44.02	668.93
121-130	12.7	120.02	331.07	39.74	708.67
131-140	13.0	122.72	291.33	35.75	744.42
141-150	13.3	125.35	255.58	32.04	776.46
151-160	13.5	127.10	223.54	28.41	804.87
161-170	13.7	128.86	195.13	25.14	830.01
171-180	13.9	130.63	169.99	22.21	852.22
181-190	14.1	132.40	147.78	19.57	871.79
191-200	14.2	133.28	128.21	17.09	888.88
201-210	14.4	135.03	111.12	15.00	903.88
211-220	14.6	136.77	96.12	13.15	917.03
221-230	14.7	137.65	82.97	11.42	928.45
231-240	14.8	138.53	71.55	9.91	938.36
241-250	14.9	139.36	61.64	8.59	946.95
251-260	15.0	140.25	53.05	7.44	954.39

<sup>a</sup>After: Beebe and Appel (4).

groupings: Psychotic Disorders, Psychoneurotic Disorders, Character and Behavior Disorders, All Other Psychiatric Disorders, and Diseases of the Nervous System. The disorders that show changing rates of incidence as a function of combat fall into the Psychoneurotic Disorders and All Other Psychiatric Disorders categories (79, February 1953).

In general, conditions reported as Psychoneurotic Disorders include anxiety, dissociative and conversion reactions; phobic, obsessive-compulsive, and depressive behavior patterns; and somatization reactions. Transient disorders caused by acute stress are placed in the All Other Psychiatric Disorders category.

However, wide differences of opinion about the meaning of the various clinical diagnoses existed during World War II (57) and the Korean conflict. Changes also occurred from time to time in the system of classification. For example, during the early part of World War II, many disorders that later would have been classified as combat exhaustion were designated psychoneurosis-battle reaction and placed in the class Psychoneurosis. During 1944 and part of 1945, the term "combat exhaustion" was introduced and cases were classified under Psychoneurosis. During the Korean war, combat exhaustion was classed under All Other Psychiatric Disorders.

In some World War II situations, soldiers who probably showed genuine psychoneurotic reactions were diagnosed as suffering from simple adult maladjustment—a transient disorder falling into the class All Other Psychiatric Disorders—so that they could be returned to duty (79, April 1954). If they had been diagnosed as psychoneurotic they would have been eligible, during most of World War II, for a disability discharge.

The semantic confusion involved in the use of this terminology and the difficulties encountered in applying these categories was resolved, to some extent, in time, through increased usage of the term combat exhaustion to describe emotional disturbances arising in combat. In the Korean conflict a directive was issued implementing the use of the term combat exhaustion to designate all psychiatric casualties among combat troops (27).

Such a procedure was consistent with the findings of the Special Commission of Civilian Psychiatrists, covering Policy and Practice in the U.S. Army Medical Corps, ETO, 20 April to 8 July 1945. This group and most of the military psychiatrists interviewed in their study (Bartemeier *et al.*, 3) concluded that the picture of psychological disorganization seen among NP casualties at battalion aid stations did not "correspond either in its moderate or in its extreme form to any recognized or established psychiatric syndrome" (p. 380). It was only later, among the soldiers who had been removed from clearing stations and sent farther to the rear to exhaustion centers where some degree of crystallization of the disorder had occurred, that some of the more familiar psychiatric syndromes could be identified in some patients.

In the following description of the different phases of combat exhaustion and some of the varying symptoms and disorders seen in psychiatric casualties, no attempt has been made to distinguish

between combat exhaustion and other possible psychiatric disorders. The terms combat exhaustion and neuropsychiatric casualty are used synonymously to designate all forms of psychiatric casualties occurring as a consequence of battle. The concern here is with the effect of various factors on combat performance and with estimates of gross psychiatric attrition, rather than with diagnostic categories.

Evolution of Combat Exhaustion. As indicated earlier, the disproportionate increase in the number of psychiatric casualties as compared to battle casualties that occurs in units remaining for some time in active combat (whether light, moderate, or heavy in intensity) has been attributed largely to the cumulative effects of combat stress. Underlying the increasing probability of psychiatric casualties in a unit as its time in combat lengthens is a progressive alteration in the response to combat stress among various members of the unit. It should be noted, however, that the origin of this process antedates first exposure to combat and may reach its climax in a few individuals even before entry into combat.

This evolutionary process can be fairly well delineated. All of its aspects are likely to be seen most clearly among men in units that have sustained intermediate levels of casualties (76, 77). In units with extremely high casualty rates, combat exhaustion develops more rapidly, and its sequence may be telescoped so that only those symptoms associated with the final phases of deterioration and complete collapse are apparent. In units with low casualty rates, the development of exhaustion is slower and more insidious, so that the milder or more subtle symptoms appearing at the beginning of the sequence may be overlooked.

While combat exhaustion generally develops in a predictable and progressive manner, there is fairly wide variation in the symptoms shown by individual soldiers, their sequence of appearance, and the rate at which the sequence develops (16). Further, there is some evidence that the pattern of symptoms is related to the rate at which exhaustion evolves, itself a function of the intensity of combat and a variety of other factors.

Several writers (3, 32, 33, 76) have indicated that when men break down early in combat, they tend to show a greater display of emotion and their symptoms are more bizarre than those observed in the breakdown of soldiers who have been in combat for longer periods of time; soldiers who have become psychiatric casualties after some duration of exposure to combat typically show symptoms of apathy and physical and mental retardation. Symptoms of the early breakdowns were described by Glass (33):

When units new to combat are exposed to severe battle stress, not infrequently there occur instances of severe behavioral disorganization that may manifest disorientation, hallucinations, and even mute, catatonic-like states. However, these conditions are transient and usually subside in from 1 to 3 days to become typical tremulous neurotic-type cases. These cases have been termed pseudopsychoses, terror states, or dissociative reactions, but represent severe types of so-called combat fatigue. Such bizarre behavior rarely occurs in veteran combat units. (pp. 190-191)

Typically the signs of combat exhaustion begin to appear after some period of exposure to battle. Fear reactions that the soldier has previously been able to control with reasonable success begin to appear with greater frequency. These reactions usually are manifested in increasing irritability and sleep disturbances (33, 77). Bartemeier et al. (3) wrote:

The irritability is manifested externally by snappishness, over-reaction to minor irritations, angry reactions to innocuous questions or incidents, flare-ups with profanity and even tears at relatively slight frustrations. The degree of these reactions may vary from angry looks or a few sharp words to acts of violence. . . . (p. 374)

In association with this "hypersensitiveness" to minor external stimuli, the "startle reaction" becomes manifest (increasingly so as time goes on). This is a sudden leaping, jumping, cringing, jerking or other form of involuntary self-protective motor response to sudden, not necessarily very loud, noises, and sometimes also to sudden movement or sudden light. . . . (p. 375)

The disturbances of sleep, which almost always accompany the symptom of increased irritability, consist mainly in the frustrating experience of not being able to fall asleep even upon those occasions when the military situation would permit. Soldiers have to snatch their rest when they can. They expect a rude and sudden awakening at any time. Opportunities for sleep become very precious and an inability to use them very distressing. Difficulties [are] experienced also in staying asleep because of sudden involuntary starting or leaping up, or because of terror dreams, battle dreams, and nightmares of other kinds. (p. 375)

With continued exposure to combat the soldier's disablement becomes greater and changes in behavior become more apparent. Bartemeier et al. have listed the following kinds of behavior as common:

- (1) General psychomotor retardation, with difficulty and slowness in doing familiar everyday acts, in recollection, in concentration and in responsiveness to orders.
- (2) A tendency to become seclusive, morose and silent, or the reverse, i.e., to talk excessively, smoke excessively, sometimes, when possible, to drink excessively.
- (3) A tendency to discard belongings with the complaint that everything is too heavy, too much to bear, etc. Such men often throw away valuable and much needed personal belongings, military equipment and even food.
- (4) An apparent "affective flattening" with a loss of interest in comrades, military activity, even food and letters from home. Food may go uneaten, letters unread.
- (5) An increased apprehensiveness and ill-concealed fearfulness.
- (6) An increasing dependence upon comrades and others, with unwonted reluctance to accept responsibility or to exert initiative.
- (7) A tendency to be confused, even to the point of slight disorientation, with impaired judgement, uncertainty of movement and the like.
- (8) Various somatic symptoms such as tremor, vomiting and diarrhea.  
(pp. 375-376)

Frequently listless and apathetic behavior becomes as severe as that of men described by Swank and Marchand (77):

... the soldier became practically nonreactive both physically and emotionally. He could then best be described as one leading a vegetative existence. His facial expression was one of complete apathy: a nonsmiling, rigid-faced person with lusterless eyes. His body was seemingly helpless, movements being performed with an effort. The soldier was in a semistuporous state, difficult to arouse from his reverie; he remained almost constantly in or near his slit trench, and during acute actions he took little or no part, trembling constantly. (p. 241)

Depending on a variety of factors, the soldier may or may not be removed from battle to the battalion aid station. For example, some soldiers may attempt, and to a certain extent succeed, in hiding their symptoms; symptoms may not be recognized or their significance may not be understood; soldiers may be kept in combat because they are needed, regardless of their disability.

If soldiers are not removed from combat, their condition worsens progressively. Ultimately the soldier reaches a state of complete disorganization and collapse. Sometimes the occurrence of a particularly traumatic event, such as a "near-miss" from mortar fire or the death of a buddy, may precipitate a sudden and dramatic reaction which practically always results in removal from combat.

The soldier may become unstable, erratic, obviously confused, savagely irritable, quite unreasonable and even defiant and recalcitrant. He may clamber out of his foxhole in the face of danger or freeze to it when danger has passed or when it is safer to go elsewhere. He may run aimlessly about, exposing himself perilously; he may stand mute, staring into space; he may go to his CO pleading that he is not fit to command his detachment. He may break into uncontrollable sobbing or screaming. His speech may become jerky, stammering and incoherent. He may babble like a baby or make smacking or sucking movements of the lips. There is apt to be some tremulousness, especially of the hands and head, physical movements become awkward and incoordinate. Nausea and vomiting are very frequent. (3, pp. 376-377)

#### Factors Affecting Combat Exhaustion

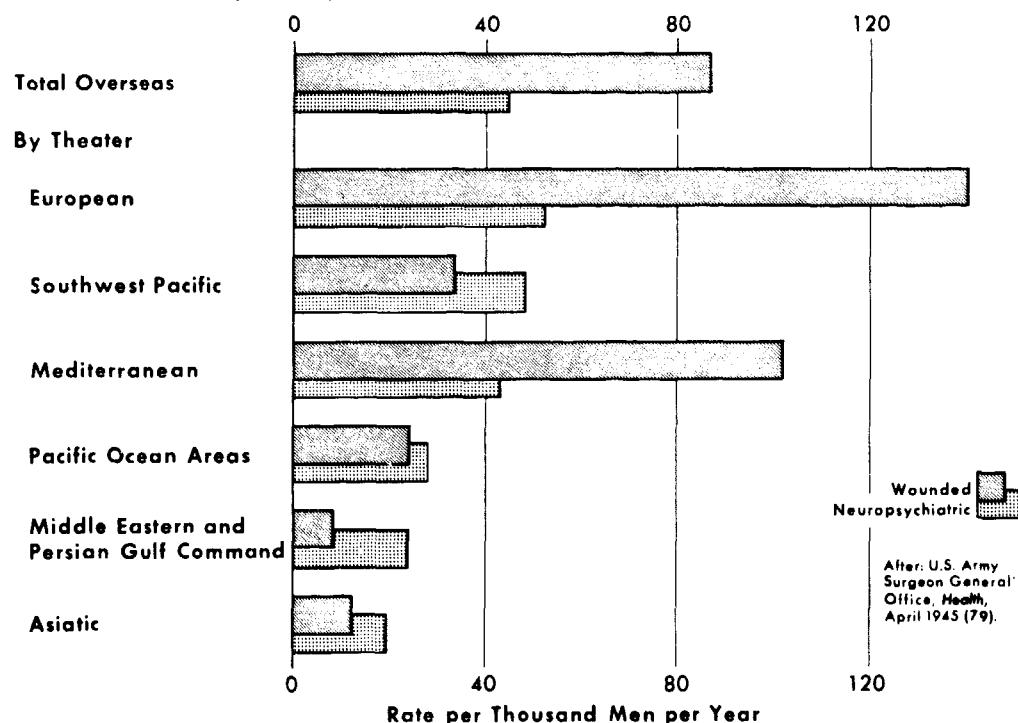
Although intensity and duration of combat are the most important factors affecting NP casualty rates, a number of other factors condition the progressive and inevitable psychological deterioration of the individual that occurs in battle. These factors affect levels of stress, susceptibility and resistance to stress, and the particular form in which psychiatric casualties find expression.

Environmental Characteristics. NP casualty rates are affected by weather, climatic conditions, terrain, and related conditions. In World War II the Southwest Pacific, with its tropical climate, monotony, isolation from civilization, danger of disease, and jungle conditions, contributed to an NP casualty rate that was completely out of proportion to the intensity of combat.<sup>1</sup> Figure 3 shows NP and wounded casualties in the U.S. Army, by theater, during 1944. That

<sup>1</sup>2; 79 (April 1944 and February 1945).

### Neuropsychiatric and Wounded Casualty Rates: U.S. Army, 1944

(Per Thousand Men per Year)



After: U.S. Army  
Surgeon General's  
Office, Health,  
April 1945 (79).

Figure 3

combat as such is not the sole cause of NP casualties during warfare is clearly illustrated by a comparison of the Southwest Pacific and Mediterranean Theaters: With a combat intensity of less than half that of the Mediterranean Theater, the Southwest Pacific reported a higher rate of NP casualties; furthermore, even with a substantial number of combat casualties, NP casualties exceeded the number of wounded.

Fatigue. Although physical fatigue in itself does not lead to psychiatric disorders, it is universally recognized that it frequently plays an important role in the development of combat exhaustion (3, 24, 29, 38, 81). Glass (33) has noted that the terminology developed during World War II to describe mental illness—combat fatigue, flying fatigue, combat exhaustion, operational fatigue—all allude to the role of physical fatigue in contributing to psychiatric breakdown.

Since combat is physically exhausting, all types of casualties frequently show fatigue effects. The general appearance of combat casualties is well described by Hanson (38):

They had obviously undergone a period of severe physical strain. They walked dispiritedly from the ambulance to the receiving tent, with drooping shoulders and bowed heads. Once in the tent they sat on the benches or the ground silent and almost motionless. Their faces expressionless, their eyes blank and unseeing, and they tended to go to sleep wherever they were. The sick, injured, lightly wounded, and psychiatric cases were usually indistinguishable on the basis of their appearance. Even casual observation made it evident that these men were fatigued to the point of exhaustion. Most important of the factors that produced this marked fatigue was lack of sleep. (p. 148)

Referring to psychiatric casualties specifically, Glass (33) states that they:

... give the impression of physical exhaustion because of their drawn and haggard appearance, slowed gait, and tendency to sleep promptly when given the opportunity. Such patients commonly respond with dramatic improvement when physical fatigue has been relieved by sleep and food. (pp. 191-192)

Where physical fatigue has been a major factor contributing to combat exhaustion, rest can help considerably to enable such soldiers to return to combat. Where combat stress has played the major role and physical fatigue has contributed minimally, the prognosis for return to combat is not good. In particular, where men have become psychiatric casualties prior to battle or after only initial contact with the enemy, rest will do little to ameliorate the fears and anxiety that have produced the breakdown (24, 32, 38).

Further evidence suggesting the contribution of physiological factors<sup>1</sup> to psychiatric disorders in combat is seen in the effects of intercurrent illness. In World War II and the Korean conflict, it was common for soldiers with malaria, hepatitis, and Japanese B encephalitis to be removed from battle as psychiatric casualties because they showed symptoms of combat exhaustion (29, 33).

Types of Tactical Situation. Neuropsychiatric casualty rates will vary as a function of several related conditions that include the type of operation and tactical situation, the type of unit, and the type of fire being received. Since NP rates vary as a function of the intensity of combat, those situations and operations associated with high battle casualties will, in general, produce large numbers of NP casualties and those situations associated with low battle casualties will produce few NP casualties.

Several types of land combat operations where battle casualties are high have been classified by Beebe, Leith, and Reister (67). Listed in order of decreasing casualty rates, they are: beachhead operations, offensive breakthrough operations, reduction of ports and towns, assault on fortified lines, river crossings, and defensive operations against strong enemy counterattack. Other things being equal, it is to be expected that all of these situations would tend to result in high numbers of NP casualties, with the largest numbers of such casualties associated with those situations at the beginning of the list.

In the case of beachhead operations, for example, during the first days of the Allied invasion of Europe in 1944 some of the largest numbers of both battle and NP casualties of the war were sustained. It must be noted, however, that during the early phases of the invasion many of the American troops received their first exposure to combat, a situation that typically results in high psychiatric attrition.

<sup>1</sup>While various explanations have been offered of how physical fatigue is related to the occurrence of psychiatric disorders in combat, the precise manner in which the two are related is unknown. Similarly, understanding of the behavioral effects of fatigue and its physiological underpinnings is poor. No effort will be made in this report to explicate the mechanisms involved in the possible relationships between stress and fatigue.

The degree to which each of these factors contributed to the high NP rates that resulted cannot be ascertained.

Relatively high NP is generally associated with a static situation, slow uphill fighting against determined opposition, a first meeting with strong opposition, the halt of rapid advance or the halt of withdrawal, or situations where there is little or no possibility of taking action, as when "pinned down" by artillery fire (27, 28). To be able to take action against a threat is both rewarding and reassuring. Aggressive action also provides a therapeutic mechanism whereby fear and anxiety are reduced (26, 56). In any situation or against any weapon where he cannot take some form of retaliatory action, a soldier's fear and anxiety will tend to increase (23); thus the fear induced by close artillery (especially the German 88mm gun) and mortar fire, where frequently one can only "sweat it out," is well known (55, 73). The stressfulness of artillery fire and its effect on NP rate were demonstrated in the Pacific when, in 1945, the Japanese first made intensive use of artillery (79, May and September 1945). Prior to this time the NP rate in the Southwest Pacific had remained high, but it did not reflect variations in combat intensity as it did in other theaters. After artillery was introduced, NP and battle casualty rates began to co-vary in a more systematic manner.

Relatively low NP is generally associated with a fluid state of battle, a rapid advance, or a counterattack—even though in the latter type of situation casualties are unusually heavy and high NP rates would ordinarily be expected. Low NP is also associated with retreats (54).

Findings to be reported in detail in Part II indicate that different types of combat troops have different NP rates at comparable levels of combat intensity. A comparison of Infantry, Airborne, and Armored divisions in the ETO in 1944 showed Armored troops to have the highest NP rate and Airborne troops the lowest. These findings are supported by information reported elsewhere (79, October 1944). In general, Armored troops both sustain the smallest number of battle casualties on an absolute basis and have the lowest battle casualty rates per man of the three groups, yet they have the highest NP rate.

It can be conjectured that these differences arise from a variety of sources, such as variations in tactical employment, type and intensity of enemy fire sustained, and constancy of combat. Confinement and high mobility may be related to the high NP rate among Armored troops, whereas the voluntary nature of Airborne duty may introduce selection factors that are related to the low NP rate among such personnel.

Potential Benefits. NP rates, as such, tend to decrease when becoming such a casualty would provide little or nothing in the way of additional safety, sickness benefit, or material advantage. This situation existed, for example, during the German retreat at Stalingrad where failure to stay with the group meant either death from exposure or capture by the feared Russians (46).

A similar phenomenon occurred among American troops during the Korean war. Describing the situation during the summer of 1950, Glass (27) writes:

Psychiatric casualties among United States troops were numerous but not excessive. Their incidence could even be considered low in view of the high battle casualty rate, the terror spread by enemy atrocities on the captured and the wounded, the series of apparent defeats, the overwhelming superiority of the enemy in numbers and weapons, and the confusion caused by enemy attacks on our flank and rear. . . . Men were forced to fight for survival. It was far safer to remain with the group than to become a straggler. Evacuation of a psychiatric casualty was best accomplished in a combat unit rather than through vulnerable medical facilities that were either on the move or fully occupied with the wounded. (p. 1388)

Again, describing the early winter of 1950-51 (28):

. . . massive Chinese Communist assaults in northeast Korea forced the withdrawal of the X Corps. In the mountainous Chosin Reservoir district, the 1st Marine Division and elements of the 7th Infantry Division were forced to fight their way out of encirclement. Their almost continuous 10-day battle to reach safety included the air evacuation of thousands of injured and wounded men from improvised rapidly constructed airfields, severe physical deprivations, intense cold, and overwhelming numerical superiority of the enemy, who attacked from all sides. Despite the large number of wounded, injured, and frostbitten patients, there were relatively few psychiatric casualties. Here again was a situation where there was little or no obvious gain in psychiatric illness. Plane evacuation was uncertain and used mainly for the physically disabled; all others had to fight their way out in a do-or-die manner. (p. 1564)

The absence of secondary gain explains why psychiatric casualties rarely become manifest during a patrol action, but rather typically occur after the patrol has reached the safety of its own lines (33). It also explains why NP casualties usually occur after rather than during battle, when the fate of an NP casualty would be uncertain, and why flying personnel in World War II often showed NP breakdown after rather than during combat missions (36, 45).

It has been reported that during the battle of Verdun in World War I, psychiatric casualties were frequent among German soldiers who were still in the line, but not among their prisoners who had gone through similar experiences. Kalinowsky (46) found the explanation in the Germans' wish to be removed from combat, while for the prisoner the war was over. In the same way he also explained reports that, during the African campaign in World War II, "There were no neurotic reactions among the German prisoners at a time when their occurrence among the fighting British troops was high."

It should not be inferred that conscious decisions of the soldier are responsible for psychiatric disturbances, or that one intentionally precipitates NP breakdown and could avoid becoming a psychiatric casualty through an act of will. Clearly, the effects of combat stress cannot be avoided. Although in some situations or in some people they may not contribute to psychiatric disturbances, they will nevertheless manifest themselves in other forms of battle failure such as deterioration in performance, passive participation in combat, self-inflicted wounds, or even as clearly organic disabilities.

The point at which these effects become evident will depend upon a great variety of factors. Our understanding of the mechanisms through which stress affects behavior is poor. Certain conditions appear to sustain, for an additional brief period of time, a person on the verge of psychological disorganization; an example is the veteran pilot who is able to fly the return leg of a combat mission but who collapses shortly after reaching his base. Whatever the underlying mechanisms may be, it is unlikely that they can be satisfactorily controlled and utilized, as the effects are short-lived.

Mutability of Symptoms and Cultural and Social Factors. The cultural background of the troops involved may affect both the type and the number of obvious NP casualties without necessarily affecting the total amount of attrition due to psychological factors. As a consequence of cultural factors, psychological attrition is sometimes reflected in ways that are not obviously neuropsychiatric. American troops in World War I and East Indian troops in World War II showed a tendency to convert their anxiety into hysterical blindness and paralysis, forms of disability sanctioned by their cultures. Later in World War II, when the expression of fear in battle was accepted by U.S. military personnel and seen as a natural response, there were far fewer cases of hysteria (disorders with symptoms that mimic physical disabilities) than in World War I but more cases of anxiety states (3, 52).

Whenever a particular bodily ailment or a psychological disorder attains an aura of medical or social respectability, it tends to become an accepted means of becoming a noncombat casualty. Glass (33) has indicated that early in the Korean war Republic of Korea (ROK) troops tended to have low NP rates, because such behavior was not socially acceptable and there were few ROK medical facilities. Other types of noneffectiveness, however, were common. When ROK and American troops were integrated, ROK soldiers began to show psychiatric disturbances with the same frequency and symptoms as Americans; they reflected the pattern accepted by their new associates.

The influence of Japanese culture and the fact that they were an out-group and could not permit themselves to show any evidence of "cowardliness" made it difficult for Nisei troops in World War II to show fear. In general they had a low NP rate, which was partly attributable to the tight cohesiveness of their groups. Psychiatric disorders that did appear among these soldiers tended to occur as cases of hysteria and were acceptable because they were "organic" (33 - comments).

One form of nonbattle casualty related to combat stress is cold injury. A relationship between cold injury and combat intensity has been shown by Beebe and DeBakey (5). The incidence of cold injury rises and falls, as do NP rates, in a regular and consistent manner with intensity of combat. This relationship is undoubtedly due, in part, to the fact that under conditions of increased battle activity men are more likely to be exposed to those conditions that can lead to cold injury and at the same time are less able to exercise cautionary measures designed to prevent it. It is also recognized, however, that a significant amount of cold injury is probably self-inflicted by soldiers

who deliberately remove their boots or intentionally avoid taking elementary precautions (17).

In contrast the appearance, during the Korean war, of a syndrome of coldness and numbness of the feet which mimics typical frostbite symptoms has been reported by Glass (28). During that winter of 1950-51 in Korea, NP casualties tended to show a decrease when the incidence of cold injury rose. This suggests that in some cases frostbite symptoms may have been an alternative to psychiatric disorders. Glass described this syndrome and suggested a mechanism that might produce this effect:

... many psychiatric casualties were concealed among the numerous soldiers evacuated for subjective complaints and nondisabling conditions, particularly among the many allegedly frostbitten patients who had only subjective complaints and no objective findings. This syndrome of "cold feet" was compounded out of the usual numbing sensation of the feet in cold weather, a conscious or unconscious wish for the gain of illness, and poor motivation. One can only speculate as to the greater vulnerability to frostbite of the potential psychiatric patient. It may be that the increased sympathetic stimulation, in such a fear-ridden person, caused excessive vasoconstriction of the extremities with a consequent decrease in blood supply. (p. 1565)

Expectancies About the Duration of Hostilities. NP casualties in the ETO decreased markedly toward the end of hostilities in 1945 (4) as soldiers became confident that the end of the war was near. Similarly, rotation policies and soldiers' beliefs about the amount of combat they must endure before they will be relieved have an effect on their susceptibility to NP disturbances. It has been suggested that British troops tended to last longer in combat before becoming psychological casualties because they believed there was little chance of being relieved before the end of the war, and they knew they would have to hold on (52).

Group Support and Unit Cohesiveness. There is universal agreement that the single most important factor that sustains a man in combat, one that enables him to continue resistance in the face of enemy superiority as well as to resist the effects of cumulative combat stress, is the powerful psychological support that he receives from his immediate primary group—that is, his squad, platoon, or company.<sup>1,2</sup>

Assimilation into and identification with the group or unit involves a number of factors (3). The soldier makes personal attachments with the leader and other members of the group. He tends to "overvalue" his group and deprecate others. He becomes more secure both as a consequence of the training that he has received for his specific job within the group and because of the support and

<sup>1,3, 25, 29, 36, 52, 53, 60.</sup>

<sup>2</sup>The importance of the primary group in coping under stress has implications for the current policy of individual replacement and for the training, organization, and management of personnel that are beyond the scope of this discussion. Its major implications are that groups be formed early, conceivably as soon as soldiers enter the Army, and that group members be kept together, with a group going into and being rotated out of combat in its entirety. Squads, platoons, and companies that have been removed from combat but are still effective could be used in toto as replacements going into larger groups. Company level groups, however, should not be reconstituted through the use of replacements.

satisfaction of his basic needs that the group provides. As a group member, the soldier shares in its satisfactions, dangers, deprivations, and discomforts, and in turn is protected by it.

The processes involved in the establishment of identification with the combat group and its consequences have been described in detail by Glass:

Group identification spontaneously arises as a defensive measure by two or more persons in response to a common menace. . . . men move toward each other both figuratively and literally for actual protection and emotional warmth. . . . First, there tends to be a displacement of quantities of self-love to concern for the welfare of other group members. Less fear is then felt for the self and the consequent decreased inhibition facilitates aggressive behavior that can be used in behalf of others. Such a mechanism accounts for heroic deeds in battle by individuals who seem heedless of personal danger because they are intent only upon securing the safety of their friends. Second, this attitude toward others reinforces the strength of conscience faculties to include the ideals and standards held by the combat group. The individual is compelled to abandon selfish desires or else not only suffers self-condemnation but risks losing the actual and emotional support of the group. Even the poorly motivated person is literally forced to adopt this prevailing group attitude since the battle situation is hardly a place to be left alone. Third, there is the effect of the group upon the character trait of passivity. The passive person identifies with the strong group and is induced to adopt their aggressive attitude. This behavior not only decreases tension but also gains group approval. (29, p. 96)

The more confidence [the soldier] has in his platoon or company, the less fearful is the battle situation. When men fight together and share common tribulation, they become bound by the closest of emotional ties. This affection, which is akin to love, serves to lessen concern for one's own life, thereby decreasing the crippling sensation of fear. That such an emotional bond is common has been demonstrated by numerous instances in which soldiers have unhesitatingly performed dangerous and heroic deeds to save their friends. The grief reaction to a man who loses a buddy in combat is only comparable to the mourning over the loss of a loved one. (25, p. 1474)

The forces of group identification thus serve to sustain both the group and the individual. The sense of duty and responsibility that men come to feel toward the group preserves the group and makes it a functioning, fighting unit. The group sustains the man by providing both physical aid and psychological support. Thus, the identification of a soldier with his unit tends to exert an effect, at least for a short period of time, even after a man has left combat as a psychiatric casualty. In such situations the desire to return to the unit can contribute significantly to his physical and psychological well-being.

Shils and Janowitz (70) have argued persuasively that the major factor underlying the unity and tenacity of the German army in World War II was the satisfaction of primary personality needs afforded by the group and not, as has frequently been suggested, by strong political convictions. They suggest that a soldier's ability to resist is a function of the capacity of his immediate group to avoid social disintegration. When his group met his basic organic needs, offered him affection and esteem from officers and comrades, and gave him a sense of power, the German soldier's concern for his own safety in battle—a factor which could disrupt the functioning of his primary group—was

minimized. When the primary group was disrupted, through separation, loss of leadership, loss of personnel, or prolonged breaks in the supply of food and medical care, there was very little "last-ditch" resistance.

It seems clear that the relatively low NP rates found in World War II among submarine and flight crew personnel, groups which were exposed to situations involving considerable stress, were due in part to the strong psychological support provided by such highly cohesive groups. Mandelbaum (52) points out that, while all members of U.S. submarine crews are volunteers and are carefully screened, the stress of submarine duty is extreme and the NP rate would ordinarily be expected to be higher than the percentage, .00044 casualties per man-patrol, that has been reported.

A similar situation is found among air crews. In the Bomber Command of the Royal Air Force (RAF), Stafford-Clark (72) reports, the wartime casualty rate was approximately 48% killed and missing, or 64% including wounded, and injured as well. Although the chance that a man would survive intact was roughly one in three, the NP rate was only 5%, an extremely low figure as compared with combat units in other branches, both British and United States.

Reference has already been made to the low NP rate among Nisei troops during World War II. While such troops (e.g., the 100th Battalion and the 442nd Regimental Combat Team) represent groups that were highly selective (they were composed of second-generation Japanese-American volunteers who identified strongly with their parents' loss of civil rights and other problems), there is little doubt that group cohesiveness engendered by these very factors contributed significantly to their low NP and generally high morale and esprit.

Finally, the effort of the Chinese Communists to break up and prevent the formation of groups among American prisoners of war in internment camps during and after the Korean conflict testifies to their recognition of the generally supportive nature of the group. The Chinese Communists attempted to destroy whatever group ties had been formed by changing the membership of groups and segregating leaders. In these situations, the presence of known or unknown informers also made it difficult to establish close personal ties. The stressful environment of the POW camp, which included starvation, inadequate shelter, threats of death, physical maltreatment, and nonrepatriation, frequently resulted in the appearance among prisoners of extremely withdrawn, apathetic, and listless behavior, not dissimilar from that seen in advanced stages of combat exhaustion (74).

Leadership. Since identification with the group and group cohesiveness are such critical factors in sustaining the soldier in the face of combat stress, leadership of the group is similarly important. If the leader meets the emotional needs of his men, shows personal courage, is loyal to and demonstrates concern for the safety of his men, provides guidance, help, and fair management, and knows and does his job well, he will maintain the prestige of his position in the military structure and be able both to motivate and to enforce discipline of the group. The group will then provide a strong defense against all forms of combat failure (25, 54, 57).

Where two groups fighting side by side show totally different NP rates, it has frequently been possible to attribute the difference to the degree of confidence that soldiers have in their leaders. The psychiatric rates tend to be high in units in which there is little confidence in the leaders, where there is high officer turnover because of casualties, and where psychiatric breakdowns have occurred among the officers and leaders themselves (79, January 1944; 80).

Management of NP Casualties. The method of management of NP casualties affects both the number of casualties and the likelihood of their returning to combat. This fact was recognized during World War I, although the lesson had to be relearned during World War II, as noted by Glass (30) and Mandelbaum (52, 53). The treatment of psychiatric casualties as far forward as possible tends to reduce the NP rate, and avoidance of a hospital atmosphere during treatment increases the likelihood that a soldier can be returned to combat. There are several explanations for this.

First, forward treatment tends to reduce secondary gain. Removal to a medical area close to the fighting does not necessarily result in an increase in safety, since such units may actually be more vulnerable.

Second, since men in combat are sustained by strong feelings of group identification, removal from combat may give rise to a conflict of goals—a desire to rejoin the fighting group and a desire to escape the combat situation (Glass, 30). Brief and early treatment in a forward area frequently succeeds because it preserves and takes advantage of a soldier's emotional ties with his group. The group is near in terms of both time and distance, so the pull it exerts upon the soldier to return remains strong. Forward treatment reinforces this effect in that it tends to suggest to the man that his disablement is only temporary and that he will be able to return to his unit. Evacuation to a safer rear-area station or hospital has the opposite effect and reinforces the man's needs for self-preservation. In addition, medical treatment with a hospital atmosphere strengthens feelings of helplessness, dependency, and disability, and perpetuates symptoms and ineffective behavior. Appel and Beebe (1) have summarized the situation well:

Once a man is evacuated from the combat area a vicious circle is set in motion. His removal from the line and admission to the hospital confirms his belief in the seriousness of his condition. Unconsciously or otherwise he has also discovered that his illness is an asset in that it keeps him out of combat. In this way he actually does become ill, the symptoms become "fixed" and he is genuinely incapacitated for further combat duty. (p. 1473)

If, therefore, for nuclear battle there is any policy of removing all types of casualties to rear areas for diagnosis or treatment, a considerable increase in the number and permanence of psychological casualties should be expected.

#### Effect of Nuclear War on Soldier-Civilian Behavior

Many questions have been asked about the probable effects of nuclear warfare upon civilian populations, either hostile or friendly troops

deployed among them, and indigenous forces charged with maintaining order, and upon the relationships among these elements, and about ways in which the effects might differ from one cultural or national context to another. For example, how could civilians of a given cultural group be expected to act toward allied or occupying troops when the presence of these troops exposes them to the use of nuclear weapons? How effective could members of the militia be expected to be in maintaining order among the civil population in such a situation? How would different groups of soldiers behave when engaged in fighting a nuclear war within their own country, or when cities within their country have become targets of nuclear attack?

While some basis can be found for conjecture about such questions, the answers are not known.

In attempting to forecast how nuclear warfare may affect civil populations and members of military forces, the following considerations appear to be of some relevance.

It seems likely that nuclear warfare would result in a considerably higher incidence of direct personal involvement among civilians than has been the case heretofore in conventional warfare. "Near-miss" experiences would perhaps predominate over "remote-miss" experiences among survivors. Adaptation among civilians to the stress of warfare would then cease to be the general rule. Instead, states of apprehension, severe and prolonged fear reactions, and widespread emotional difficulties may be anticipated. Perhaps a general apathy would become the dominant response among surviving civilians.

In general, it seems likely that soldiers would sustain themselves better psychologically under the stresses of nuclear warfare than would civilians, for several reasons:

(1) Soldiers would have been trained for survival under conditions of nuclear warfare; they would be expected to have a somewhat better understanding of it and to be less vulnerable to its stress.

(2) The soldier's primary group (squad, platoon, and perhaps as high as company) would be expected to provide strong psychological support which would help sustain him under the stress of nuclear combat.

(3) Soldiers would generally be able to take some form of direct action—however small it might be—against the threat, and action reduces stress and is of positive psychological value. The soldier is not as helpless as the civilian, and would be less likely than a civilian to perceive himself as helpless in the face of nuclear warfare.

The strength of the soldier's immediate primary group would be a critical element in helping him cope under nuclear stress. The effect that separation from the primary group had upon the likelihood of surrender among soldiers in the German army early in 1945 was pointed out by Shils and Janowitz (70):

The tactical situation of defensive fighting under heavy American artillery bombardment and the deployment of rear outposts forced soldiers to take refuge in cellars, trenches, and other underground shelters in small groups of three and four. This prolonged isolation from the nucleus of the primary group for several days worked to reinforce the fear of destruction of the self, and thus had a disintegrative influence on primary group relations. A soldier who

was isolated in a cellar or in a concrete bunker for several days and whose anxieties about physical survival were aggravated by the tactical hopelessness of his situation, was a much more easily separable member of his group than one who, though fearing physical destruction, was still bound by the continuous and vital ties of working, eating, sleeping, and being at leisure together with his fellow soldiers. (p. 289)

The extent to which the primary group is able to maintain its integrity and resist disintegration will materially affect the capacity of its members to withstand the stress of nuclear combat. It should be noted that other factors, in addition to isolation, that tend to be disruptive of the primary group—loss of personnel and leadership, breaks in communication, disruption of supply and medical care—appear more likely to be present in nuclear combat.

When a soldier fights within his own homeland, there would appear to be additional forces that sustain him under severe strain. Maskin (56) has suggested that a man who is fighting to save his family or home is likely to feel both rewarded and reassured by his efforts. Also, a familiar cultural and geographic context probably attenuates anxiety.

However, when part of the soldier's home area is occupied or when the soldier himself is fighting in that area, the hold of the military primary group may be lessened. Shils and Janowitz (70) reported that when these conditions existed in Germany in 1945, soldiers exhibited a strong tendency to desert homeward. The same authors also report that many German prisoners of war indicated that discussions of possible alternative courses of action arose among soldiers when they were talking about their families, rather than when discussing the war. To prevent preoccupation by the German soldier with the plight of his family, soldiers' families were given strict instructions to avoid mentioning family deprivations in letters to the front. During early 1945 when Allied air raids became particularly destructive of the civilian population, all telegrams to soldiers had to be passed by party officials to ensure that such news did not reach the combat areas.

When military personnel are fighting within their own country or when their country is under attack, there is likely to be a strong conflict between allegiance to the military primary group and a desire to aid civilian primary groups, especially the family. Whether soldiers will desert in order to go to the aid of their families will depend on a wide range of factors in the specific situation. Regardless of whether there is complete disintegration of the military primary group and actual desertion, such conditions are likely to result in a lessening of the group's solidarity and its capacity to provide psychological support for the soldier under stress. Thus one of the primary supports of the soldier in coping with the stress of nuclear combat may be lost or appreciably reduced when that combat is carried to his home.

It would be naive to attempt to predict how different cultural groups are likely to act solely as a consequence of exposure to nuclear warfare, since the response of any group of people to any situation typically depends on a wide variety of factors—historical and social as well as situational. We do not know all of the factors that would need to be taken into account (e.g., the structure of specific cultural groups, the

kinds of communication systems, the way in which either will be altered under conditions of severe stress), nor do we know how they would interact, or how they would be affected by the stress of nuclear combat.

While we can predict in general how individuals are likely to respond to certain situations, our understanding of how groups of people act and will act in specific situations is quite poor, especially if cultural or national aspects must be considered. For example, in the uprisings against the Communist regimes in East Germany in 1953 and in Hungary in 1956, the intensity of popular response and support for the uprisings was apparently not anticipated by the governments involved or possibly even by the leaders of the revolts themselves. The introduction of nuclear weapons as a consideration will simply add another complication to an already uncertain picture.

#### **PREPARATION FOR STRESS**

Before a training program to prepare soldiers for the stress of nuclear combat can be constructed, it is necessary to gain some understanding of the ways in which people behave when under severe stress.<sup>1</sup>

Observations of the behavior of military personnel in combat (3, 36), civil populations exposed to air warfare (39), and persons who have experienced repeated civil disasters (20) provide information on the ways in which persons respond when faced with the threat of physical danger, death, and annihilation. However, the acute and precipitous nature of stress in these situations and the chaotic nature of the situations themselves severely limit the observations that can be made. A more serious limitation is that the observer himself is under stress.

Situations in which stress is less acute and is extended in time, rather than compressed as it is in combat, offer more adequate conditions for observing reactions to stress and their sequence of development. Information about reactions in such situations can be obtained from observations of persons with severe or terminal illness (7, 61, 68, 69), mothers of children with fatal diseases (48, 62), patients anticipating major surgery (41), persons who have had major portions of their body removed through surgery (67), persons awaiting death by execution (11), persons in mourning (50), and persons in concentration and POW camps (10, 74).

#### **Coping Mechanisms**

Fear and anxiety induced by stressful situations cannot be sustained indefinitely. If a highly stressful situation that cannot be avoided or

<sup>1</sup>Stress can be and has been defined in a variety of ways, depending on the point of view and purpose of the investigator (e.g., in terms of situational factors, behavioral responses, or physiological responses). In this report no precise definition has seemed necessary. With some exceptions the term as used here has referred to a state of the organism that is assumed or inferred whenever there is awareness of physical danger or a direct threat to life. A more adequate general definition should probably take into account the manner in which levels of uncertainty are related to stress, since the behavioral consequences of impending death or harm, when accepted as certain, may be quite different than when death or harm is seen as only likely.

eliminated is not to be overwhelming, the individual must somehow find a means for handling or reducing his fears and anxiety. The psychological means by which people cope with the fear and anxiety of stressful situations exist in considerable number. Such defensive mechanisms include such behavior as acting as if a stressful situation did not exist or as if it were not stressful (denial), making a conscious effort to avoid thinking of the experience or situation (suppression), exclusion from consciousness of the experience or situation (repression), maintenance of strict control over all forms of emotion or affect (constriction), withdrawal and regression, personal conviction of one's invulnerability and omnipotence, fatalism, and reliance on magical and superstitious thinking.

Whether any particular form of defense is adequate depends largely upon the duration and intensity of the stress that aroused it. Certain of the mechanisms may work reasonably well where stress is of low intensity or where exposure to stress is brief, but may be totally inappropriate and impossible to maintain in the face of severe or continuing stress. Brief stressful episodes may be dealt with relatively simply. For example, while denial is generally an inadequate or mal-adaptive defense mechanism, it may suffice if it need not be maintained for any length of time in the face of evidence to the contrary, as when a person tells himself that an inoculation or a tooth extraction will not hurt.

Enduring stress requires more elaborate defenses in depth. For example, the comprehensive training program for natural childbirth would seem to invoke a considerable number of defenses, including such mechanisms as intellectualization, suppression, constriction, and even some amount of denial. To meet the stress of nuclear combat, a specific training and indoctrination program with the objective of enabling soldiers to organize adequate defensive or coping mechanisms will need to be designed.

The following examples illustrate coping mechanisms of varying degrees of adequacy.

A belief frequently encountered among soldiers is the notion that while others may become casualties, they themselves will survive. Evidence of the supportive nature of such beliefs is given by Janis (39) who reports a study in which air crew officers were asked a direct question about their feelings of invulnerability ("Did you feel that while others might be hurt or killed it couldn't happen to you?"). Officers who suffered psychological breakdowns during or after their tour of combat gave fewer positive answers to the question than did men who did not break down. Those men who believed in their own survival were less likely to become psychiatric casualties.

Fatalism was widespread among the bombed populations of England, Germany, and Japan, according to studies cited by Janis, and such attitudes sometimes prevented people from taking ordinary precautions. Fatalistic attitudes were typically reflected in statements such as "everything will be destroyed anyway," "fate will decide who is next," "if your name is on it a bomb will get you, otherwise not, so why worry." Janis also suggests that the increased religious interest

noted among the British during the bombing of Britain was probably related to the development of fatalistic attitudes.

The supportive role played by religious feelings in soldiers in combat is well known. Some of the psychological mechanisms that are seen in soldiers' efforts to invoke feelings of God's protection have been characterized by Hamburg (37):

While this feeling is most often directed toward God's protection in keeping them alive, it sometimes accompanies the anticipation of imminent death, and in this instance its impact might be verbally expressed as follows: "I'm not afraid of dying because God will take care of me *after* I die." These two aspects of the use of religious feelings as an emergency defense often go together; that is, the soldier feels that God will probably protect his life and let him avoid death, but will also take care of him in case he should die. Thus he is prepared either way, for whatever may happen. (p. 227)

Suppression and denial are mechanisms often employed to handle the anxiety involved in physical illness. Behavior frequently seen among cancer victims that leads to delays in seeking treatment has been described by Shands *et al.* (69). These defensive maneuvers are characterized as (1) avoidance, where the person overlooks the lesion; (2) suppression, where the lesion is noticed and considered unimportant; and (3) denial, where the significance of the lesion is suspected but dismissed.

Denial behavior has also been observed in postoperative amputees. Hamburg (37) reports that it is quite common for postoperative patients who have just had amputations to wonder why the doctor did not remove the limb when he had said that he was definitely going to do so. Sometimes the loss of a limb will be denied for several days or a week.

The coping responses seen among persons whose lives are in immediate danger, due to such conditions as severe burns, organic heart disease, postsurgical crisis, severe poliomyelitis, and cancer, have been surveyed by Hamburg. He has broadly classified defensive psychological reactions to the threat of death as follows:

- Type 1. Processes which tend to make the patient feel that his life is not really in danger. The verbal equivalent of this orientation is, "I am not sick at all." Or, "It is only a minor injury, it is nothing to worry about."
- Type 2. Processes which tend to make the patient feel that, even though his life is in imminent danger, it does not really matter—that is, he is not concerned by his impending death. Thus, he says, in effect, "Yes, I am going to die, but it does not bother me."
- Type 3. Processes which tend to make the patient feel that, even though his life is in danger now, it will not remain in danger—there is something that can be done to correct the situation. He says, in effect, "I know how sick I am but I think I will get over it." (p. 224)

Emotional withdrawal, repression, and the development of apathy as defenses against the stress of life in a POW camp have been reported (74). Such behavior may become so extreme as to result in death. Indifference, uncommunicativeness, and apathy have previously been

discussed as adjustive mechanisms that may appear in the combat soldier as he attempts to remove himself from the stress and trauma of battle.

Successful mechanisms for coping with anxiety induced by the possibility of thermonuclear warfare (in general a relatively mild form of stress) are seen in the population at large as well as among research personnel working directly on matters related to the use of nuclear weapons. Anxiety is managed by some through suppression of the thought of danger, in the belief that nothing can be done to prevent it anyway. Others handle anxiety by engaging in activities, such as peace movements, which are designed to reduce the likelihood of war.

Mechanisms of suppression and denial are, however, of limited value in dealing with the stress of combat since, as Glass (29) has pointed out, the impact of realistic danger in battle usually leads to the rapid collapse of such shaky mechanisms. Janis (39) has suggested that the increase in emotional responses seen among civilians following one or more "near-misses" is due to the fact that the nature of such experiences makes it difficult for the individual to maintain feelings of invulnerability or other defense mechanisms that have previously served to control his emotional reactions.

Several studies cited by Janis (43) suggest that, in a variety of different situations, denial and the suppression or repression of emotion are associated with later difficulties and emotional disturbance. One study involved a comparison of women who had undergone normal labor with those who had developed severe uterine dysfunction, a type of disorder assumed to be a manifestation of acute anxiety in response to the stress of childbirth. The women who had suffered dysfunction were found to be more likely to have had a history of "suppression or repression of feelings of tension." (p. 24)

In another study, cancer patients who had delayed coming to a clinic for diagnosis and who tended to deny the implications of their symptoms before being hospitalized were compared with cancer patients who had come in promptly. The delayers were more likely to demonstrate aggressive reactions—becoming resistant and hostile, refusing treatments, rejecting the hospital regimen, and creating management problems in the wards.

Another study dealt with American women in World War II who became emotionally upset when their husbands or sons were drafted into service. The most extreme reactions of emotional shock occurred in those women who had been unworried about the coming separation and who had clung to unrealistic beliefs about the man being continually deferred or being allowed to live at home after entering service.

In another study, men who became psychiatric casualties during combat flying were compared with men who had similar air combat experience but had not developed neurotic symptoms. Psychiatric casualties were characterized by unrealistic enthusiasm for combat flying during the early part of their tour and marked loss of feelings of personal invulnerability after experiencing actual combat. Janis indicates that this study, together with other studies of military combat, strongly suggests that men who repressed fear by denying danger were

more likely to develop symptoms of irritability, depression, or anxiety during combat.

Inadequate defenses and initial responses to extreme stress frequently tend to be modified with the passage of time. This process can be seen in the sequence of responses to severe stress observed among cancer patients (45, 68) and in mothers of fatally ill children (48, 62). Shands (68) reports that when persons are initially told that they have a cancer they show a dazed reaction compounded of emotional shock, apathetic numbness, feelings of depersonalization, and inhibition of action.<sup>1</sup> Gradually they become preoccupied with the disease, direct hostility and blame onto doctors, nurses, and others, and deny the implications of the illness. These maladaptive responses ultimately disappear during a process of readaptation during which the patient frequently assumes the role of a helper. He thus finds a way of obtaining satisfaction from his interactions with doctors, nurses, family, and friends. He is able to plan his actions in a realistic manner and take account of the limitations imposed by his illness.

Knudson and Natterson (48, 62) reported that when mothers first learned that their children were fatally ill (leukemia or fatal tumors) they either denied the implication of the disease, or reacted hysterically by withdrawing, weeping, or clinging to the child physically. Those mothers who received the information long before the end were able to make a satisfactory adjustment. As they participated in the care of their children and aided nurses, they gradually became calm, ceased crying, and wished for an end to the child's suffering. At the time of death these mothers tended to be sorrowful but relieved. In contrast, those mothers who had short periods of forewarning before the death of their child, and did not have an opportunity to adapt, tended to be anxious, tense, or hysterical at the time of death.

#### The "Work of Worry"

The basis of a possible approach for preparing soldiers to face the severe stress of nuclear combat may be found in the work of Janis (41, 43) and the concept of the "work of worry." Janis has extensively reviewed the manner in which a working through of traumatic and stressful events or "grieving" among victims of wartime and civil disasters, and among cancer and surgical patients appears to sustain such persons, enabling them to assimilate disturbing information and cope with stressful events without becoming emotionally disturbed. His study of surgical patients indicates that if anticipatory fear is stimulated

<sup>1</sup>It should be noted that the dazed and stunned reaction, accompanied by inhibition of action, is similar to those responses seen in victims of civil disasters and among combat soldiers suffering emotional disorders. In all instances the person appears to protect himself by blocking external stimuli or inputs from reality.

A parallel is to be found among persons learning radio code (IMC). Here when signal rates are increased sharply, students tend to exhibit a sort of "apathetic-shock" and appear not to hear the incoming signals. They may show hostility much in the manner of persons under severe stress. When they discover that they can cope with the increased rates, their confidence returns and their performance improves (S.J. Goffard, personal communication).

moderately prior to surgery, a working-through process or "work of worry" can play an important role in helping the patient to cope with subsequent stress.

This "work of worry," or gradual adaptation to a stressful situation prior to the actual occurrence of the threatening event, is analogous in many ways to the therapeutic role of mourning following the death of a loved one, or such behavior as is sometimes seen among victims or observers of disasters in which they attempt to assimilate what has happened by continuing to stare at the consequences of the disaster.

The "work of worry" can begin as soon as a person is convinced that he faces a genuine threat of potential danger. In it a person thinks about the implications of the threatening situation, becomes affectively involved, and develops defenses against fear. These defenses replace tendencies to deny danger and other mechanisms serving to ward off and protect the person from unpleasant fear and anxiety. The person develops reality-based cognitions and expectations about how he can survive the impending danger, which serves as a source of hope and reassurance. At the same time he develops reality-based plans for taking protective actions in case various contingencies arise, which serves to reduce feelings of passive helplessness.

Janis' work with surgical patients was designed primarily to determine how persons who display different degrees of anticipatory fear react when they later undergo the acute pain, bodily discomforts, and severe deprivations of the postoperative period. He classified these patients into three classes: (1) Persons with extremely high preoperative fear—such persons were constantly worried and agitated and showed marked sleep disturbances; they sought reassurance but were only momentarily relieved when they received it; they often attempted to avoid or postpone the operation. (2) Persons with moderate preoperative fear—such persons were occasionally tense and worried about specific aspects of the impending operation but they were relieved when given reassurance; they were calm most of the time. (3) Persons with extremely low preoperative fear—such persons were constantly cheerful and optimistic, denied feeling any concern or worry, and showed no overt form of tension; they slept well and kept themselves occupied by reading and socializing.

The conclusions reached by Janis can be summarized as follows:

(1) Persons with extremely high preoperative fear were more likely than others to show extreme anxiety reactions after the operation. These persons chronically suffered from neurotic anxiety and their excessive fears about body damage can be viewed as a continuation of their neuroses.

(2) Persons with moderate preoperative fear were much less likely than others to show any form of emotional disturbance after the operation.

(3) Persons with extremely low preoperative fear were more likely to show reactions of agitation, hostility, and resentment after the operation.

Janis showed that these results could not be attributed to differences in the patients' background characteristics or to differences

in their medical condition. He also showed that, with the exception of those persons who showed extremely high anticipatory fear, pre- and post-operative emotional behavior could not be viewed as typical for the personalities involved. On the basis of his findings Janis suggested that:

The arousal of anticipatory fear prior to exposure to a stressful life situation is one of the necessary conditions for developing effective inner defenses that enable the person to cope psychologically with stress stimuli. . . . the effectiveness of the inner defenses that are erected depends upon the degree to which the person can overcome the powerful spontaneous tendency to *deny* the possibility of being personally affected by an impending source of danger. The evidence strongly suggests that if certain (nondenial) types of inner attitudes are formed before the danger materializes, the chances of developing traumatic or disorganized emotional symptoms are greatly reduced. (pp. 18, 19)

He explained that those persons in whom anticipatory fear had been aroused prior to the operation appeared to mentally rehearse the unpleasant happenings which they believed would occur. Their anticipatory fears motivated some patients to obtain and assimilate information about the experiences they would undergo following the operation. When previously predicted unpleasant consequences occurred, these patients were not surprised but rather tended to feel reassured that events were proceeding according to plan.<sup>1</sup>

Those persons who had displayed extremely high anticipatory fear prior to the operation seemed to have derived little benefit from having rehearsed unpleasant possibilities in advance. Such persons appeared unable to develop effective defenses for coping with the threat either before or after the operation. Janis suggested that in such cases surgery was only the precipitating factor setting off chronic anxiety responses.

While persons who had shown moderate amounts of anticipatory fear developed ways of reassuring themselves when their fears were strongly aroused, this form of self-reassurance was rare among persons who had shown a low degree of preoperative anticipatory fear. While these persons remained calm before the operation, they became extremely agitated as soon as they began to experience the pain and stress that accompany recovery from major surgery. Lack of worry beforehand was in effect lack of preparation for coping with stress.

A survey of a large number of male surgery cases indicated that men who had been told beforehand about specific unpleasant experiences that would occur reacted quite differently from men who had not been informed. The former were more likely to be worried before

<sup>1</sup>Various persons have written of the role of the doctor as a prognosticator who predicts the course of a disease and *thus inspires confidence*. Shands *et al.* (69) cite a case in which a cancer patient was told that she had a recurrence of her disease. When a consulting radiologist reviewed her X-ray and expressed doubt regarding the nature of the lesion, the patient's response was one of dismay rather than of pleasure. Her immediate distress was caused by the disagreement among experts and the indeterminate nature of the situation.

For an interesting discussion and examples of the manner in which people in general find reverses and disaster acceptable if they have been predicted beforehand, see Ruth Benedict's *The Chrysanthemum and the Sword: Patterns of Japanese Culture* (8).

the operation but less likely to become emotionally upset after the operation.

Pertinent conclusions from Janis' studies of surgery patients and intensive examination of the disaster literature may be summarized as follows. In general, fear-arousing communications activate the "work of worry." These communications may be official warnings from persons in authority or warnings that persons infer from their observations and their understanding of a specific situation. A moderate level of fear is the most effective in preparing for danger. The "work of worry" is seen as increasing the level of tolerance for later threat. The more thorough the "work of worry," the more reality-tested will be a person's conception of a situation and his self-assurances. Consequently he is likely to have more confidence in them and thus have greater emotional control under subsequent conditions of threat.

#### Information and Training

The way in which a man responds in any situation depends upon how he perceives it. The manner in which he perceives it depends on the type and form of information that he has about it. If a man is confronted with a complex and chaotic situation about which he is uninformed, it will be stressful for him.

Apart from the obvious danger of the situation, a man thrust into nuclear combat with a poor understanding of the situation would find himself under extreme stress. Further, since misconceptions about the nature of nuclear warfare are widespread, it is possible that he will have developed his own notions which would make the situation more stressful than warranted by the actual danger. It cannot be over-emphasized that the information and training a soldier receives and the knowledge he retains and accepts are likely to be critical in determining his over-all behavior on the nuclear battlefield. The manner in which a soldier would respond to the stress of nuclear combat is likely to depend to a large degree on the extent to which he has examined the situation and developed a realistic appraisal of it, the extent to which he understands possible or likely consequences of alternate ways of acting, and the extent to which he feels assured that he possesses the skills that would be of most use to him in facing the situation.

#### The Training Approach

Two objectives and types of training for nuclear combat can be distinguished. The first is designed to provide the soldier with skills and knowledges that he needs in order to fight and survive in a nuclear environment. The second is designed to provide psychological support, intended to sustain him, insofar as possible, in the face of extreme stress. The following discussion deals almost exclusively with the latter type of training. Matters having to do with training for the acquisition of specific combat and survival skills are outside the scope of this report, although a clear need exists at present for the systematic development and administration of such training. However,

since training for nuclear combat that is designed to serve a psychological purpose is dependent upon training that provides specific skills and knowledge, both types of training need to be developed and administered concurrently in a single training program.

The primary question may be stated as follows: How can soldiers who may be expected to fight a tactical nuclear war build up and maintain, for some period of time at least, tolerance for extreme combat stress? From what is known about reactions to stressful situations in general and disaster situations specifically, traumatic effects will be minimized if there is adequate forewarning and psychological preparation (20). It is fairly well established that pre-stress conditioning is a major determinant of tolerance for stress and that continued coping and adaptive behavior depends very largely on the type of preparatory information and activity made available prior to the advent of the threat (39, 41, 43, 49, 64). Factors that would bear on a training program for increasing tolerance for stress also have been studied in a specific experimental situation (47). It seems likely that a person will develop feelings of confidence at the same time that he acquires skills that enable him to exert some measure of control upon his environment, provided that during training elements of the situation which can actually reduce confidence are carefully controlled.

To provide military personnel with appropriate information and training on the character of tactical nuclear combat, it seems desirable to introduce a comprehensive training program, carefully constructed and administered. However, there are many unanswered questions regarding how and when such a program should be presented. Should it be given early during military training when soldiers' ideas about the Army in general and combat specifically are being structured? Should it be introduced later when a basic knowledge of combat procedures and operations may form a more meaningful context within which a soldier can fit such information? Should it be given over a period of time and, if so, how is this best accomplished from a pedagogical and psychological point of view?

Since in peacetime the threat of nuclear war is remote and unreal to the average soldier, it is not likely that any useful psychological or emotionally therapeutic purpose can be served by extensive peacetime indoctrination about nuclear combat. Perhaps only during mobilization or times of world crisis or an awareness of impending hostilities would an indoctrination program to promote the adoption of reality-based defenses against fear serve a psychological purpose. Where danger is not imminent, it is likely that an indoctrination program will merely provide or modify knowledge and skills without affecting changes in the capacity to cope under stress.

It cannot be expected that persons will develop firmly based and integrated behavior patterns to cope with situations that they do not see as real. Nevertheless, it is necessary that attention be given to the development of such a program and that this program be administered regardless of the world climate. At the very least it will serve its other function—that of providing specific skills and knowledges for fighting and surviving in a nuclear environment. As is the case in

evaluation of much peacetime training, it is perhaps likely that we will only be able to assess the psychological effectiveness of such a program in the event of war.

### Training for Stress

In order to design appropriate training for coping with stress, it would be desirable to know the following:

- (1) What are the characteristics of information that aids in subsequent coping with stress?
- (2) What types of information and what other factors induce effective anticipatory behavior in persons who will later be placed in a stressful situation?
- (3) What kind of information under what conditions produces overreactions and emotional sensitization that lead to nonadaptive behavior and a failure to cope adequately with later stress?
- (4) What factors are related to underreactions to information about future stressful events, and to apathy, indifference, and denial?
- (5) To what extent can confidence in one's knowledge and capacity to perform be expected to reduce fear, especially in situations where one's actions might have minimal effect on the threat?

Unfortunately our knowledge is such that we have nothing approaching detailed and definitive answers, of sufficient generality, to these questions. However, the work of Janis described in the preceding section at least suggests an approach to the problem. Janis has postulated that the person whose anticipatory fear is stimulated moderately will be best able to adapt to the actual stress situation. The training problem then becomes in part one of how to achieve a moderate degree of fear. Janis (42) suggests:

It will probably prove to be advantageous to present well-balanced communications with respect to two general types of content: (a) fear-arousing statements which describe the impending dangers and deprivations in sufficient detail so as to evoke a vivid mental rehearsal of what the crisis situations will actually be like, thus reducing the chances that subsequent adverse events will be frighteningly ambiguous or surprising; and (b) fear-reducing statements which describe realistically the favorable or mitigating aspects of the threat. . . . (p. 66)

A portion of the following discussion contains further explanation of Janis' views and their application to the design of preparatory information for nuclear combat.

### Confidence and Information

The possibility of exposure to radiation is highly stressful for many persons. Extreme fear and anxiety responses totally out of keeping with the actual danger of the situation are indicated in anecdotal reports of the behavior of relatively knowledgeable persons who were

in industrial accidents involving radioactive materials.<sup>1</sup> Observations of military personnel in simulated nuclear exercises indicate that people with limited information are also extremely fearful of exposure to radiation. Several HumRRO studies over a period of years have found Army trainees poorly informed about radiation and its effects (9, 12, 60).

Training and the communication of information to soldiers about tactical nuclear combat serves to provide psychological support in a variety of ways. In learning about the nuclear environment and how he can operate within it, the soldier not only gains information but clarifies previous oversimplifications and misconceptions, such as the notion that "everyone within range is killed and everyone far enough away is unharmed." Since the unknown—in this case, being uninformed, being in a situation that is ambiguous or not understandable, not knowing what to expect, and so on—is stressful, merely providing information about the conditions and consequences of nuclear combat will generally tend to reduce stress and increase a soldier's assurance or confidence in himself.

Further, as a soldier acquires specific skills that permit him to operate in a combat environment, his self-confidence increases. The role that greater self-confidence, based on training and a better orientation, can play in reducing psychological casualties was demonstrated in the Korean war during the winter of 1951. Here, when a battle indoctrination course was introduced among infantry replacements, there was a sharp decrease in the incidence of self-inflicted wounds (28).

It is important that accurate information be provided before misconceptions and rumors develop. Unpleasant information cannot be suppressed; people will seek out information and pass it on to others. Even if it were possible to suppress information, exaggerated rumors would spread, accompanied by beliefs that "things are so bad we cannot even be told about them." Further, attempts to suppress information lead to inconsistencies, and ultimately to a loss of confidence in leaders, whether or not they themselves have provided information.

#### Anticipatory Fear and Acquisition of Information and Skill

The need for information about impending stressful events, in order to counteract the tendency to discount or deny danger and to modify attitudes of personal invulnerability, has been pointed out by Janis (43). Accurate and realistic information about the character of nuclear combat, and the role of the soldier in it, can be expected to elicit some degree of anxiety or anticipatory fear. This fear can be used to stimulate efforts by the soldier to acquire skills and knowledge appropriate for nuclear survival and thereby to develop reality-based defenses against fright.

To accomplish this, stress-inducing information must be presented in a careful and progressive manner in order to keep to a

<sup>1</sup>In an intensive interview study in connection with planning for a civil defense public educational program, Janis (39) reported that even the most sophisticated persons showed oversimplified conceptions of the effects of an atomic explosion.

minimum sudden increases in the arousal of strong fear responses. If a soldier's understanding of nuclear combat can be developed in an orderly manner, the "work of worry" can be stimulated. Otherwise he will tend to engage in denial and invoke other protective mechanisms against anxiety.

Anticipatory fear and self-initiated rehearsal of future events frequently lead to spontaneous efforts to develop personal techniques for coping with anxiety. Preparatory information and training, in addition to inducing anticipatory fear, provide the soldier with both a knowledge of what he can do to minimize the danger of the situation and a capacity to do it. Thus the process is a circular one. Preparatory information elicits controlled amounts of anxiety, which in turn operate as motivating forces prompting the soldier both to seek additional information about the situation and to rehearse or prepare himself for what can be done. The knowledge which elicits the anxiety serves to reduce it when coupled with information about how the situation can be handled. Additional information and training provided by authorities and sought by the soldier further increase his understanding of the situation and his capacity for surviving in it, thereby increasing his own confidence or self-assurance.

The critical aspect of this process is that stressful information about nuclear combat be presented in a controlled, stepwise fashion, so that denial responses and other maladaptive defense mechanisms can be kept to a minimum and reality-based defenses against fear will form. Only in this way will preparatory information, which taken as a whole would otherwise be quite stressful, help in the building of attitudes of self-confidence that can be maintained as combat approaches and becomes an actuality.

#### Preparation for Stress and Response to Command

Initiating controlled anticipatory fear, maintaining "the work of worry," and providing for the development of reality-based expectations and defenses through training have important implications not only with respect to a soldier's ability to resist the effects of combat stress but possibly also as to the extent to which he can be expected to remain trustful of and responsive to persons in command.

If a person is not given appropriate preparation and training for stressful events and does not engage in realistic self-preparation, it is likely that when danger does occur his efforts to cope will break down. He can then be expected to show intense fear, for he has developed no realistic means of coping with the threat. The threat itself is likely to appear more severe than it may really be, if only because of the disparity between his incorrect expectations and those imposed by reality. The extreme emotional responses that can suddenly appear when minor or unexpected events shatter a person's defensive beliefs have been reported frequently among combat personnel (36) and surgery patients (41).

At a time of crisis when maladaptive defense mechanisms give way, there is a tendency to project blame upon authorities for the

unanticipated stress and danger. The mechanism may be summarized as follows. A failure to anticipate, develop, and rehearse actions appropriate for dealing with impending danger leads to feelings of extreme helplessness when the danger materializes. This in turn leads to disappointment and to mistrust of authorities who failed to predict or give warnings about the dangers that would arise. The greater the disparity between the stress and danger that materializes and the stress and danger that were anticipated, the greater the probability of disappointment in those who hold positions of authority (and who are expected to protect one from danger). Mistrust and disappointment lead both to hostile and aggressive responses toward persons in authority and to increased feelings of vulnerability. That an inability to cope with stress may lead to a mistrust of commanding officers has been observed among men in battle (3, 36); these observations support the application of Janis' analysis to the combat situation.

#### Training Content and Method

With our present state of knowledge, only limited and very general suggestions can be offered about what the content of a program of training and indoctrination should be.

(1) Training should provide the soldier with an accurate picture of what the nuclear environment will be like for him and what he can do to protect himself. Rehearsal and preparation should be specific to the situation in which the soldier may find himself. Every effort should be made to cover all contingencies that might arise and explanations should be provided for all things that a soldier might see or have to do. For example, soldiers should be told about epilation and the significance of losing one's hair after exposure to radiation. Otherwise their fears about this strange symptom and its consequences can be expected to be greatly exaggerated. Similarly, the purpose of protective clothing and equipment issued to certain personnel, which the ordinary soldier might see but not have, should be explained, and so forth.

(2) The soldier should not be given nuclear information for its own sake. This is a frequent error in military and other instruction where the temptation is great to include information that is relatively easy to organize and present, though irrelevant to the purpose to be accomplished. Thus no information should be given about the physics of nuclear activity and atomic devices (not as unlikely an occurrence as might be believed) or about obscure physiological reactions as a consequence of radiation. The former type of information is merely irrelevant, but the latter can be quite disturbing and detrimental, giving rise to a variety of unnecessary fears.

The general rule is to avoid presenting information about things that will normally remain outside the soldier's experience, but to cover situations that the soldier might encounter, since unanticipated and ambiguous experiences can be quite stressful. An apt illustration of this phenomenon has been supplied by Janis (43), who noted that patients in hospitals frequently believe that something has gone

seriously wrong and become quite upset if they see members of the staff dressed in green uniforms rather than the expected white ones.

(3) Clear and unambiguous information should be provided in such a program. The desirability of this approach is illustrated by the observations of Rosen (67) and others on physicians who frequently foster denial of the unpleasant consequences of injury and impending stressful events. Such remarks as "everything will be all right, just leave the worrying to me" are often made in the belief that this is all that the patient wants to hear (which may be true) or that it is what the patient should hear. The ultimate psychological consequences of such a course of action are frequently not foreseen.

(4) The timing of presentation of preparatory information is critical. Janis (42) has mentioned authorities "who severely frighten people long in advance of a crisis, giving alarming information before it can properly be evaluated and assimilated, stimulating defensive reactions which preclude the normal work of worrying."

In certain situations, providing information before it is needed can reduce its effectiveness. For example, in the Kansas City flood and fire of 1951 in which the homes of approximately 20,000 persons were damaged or destroyed, most of the residents did not leave their homes until it was too late to do so in safety, despite the fact that they had received warnings during several days preceding the crisis. A disaster research team report indicated that "the very fact that it was possible to issue warnings long before the danger was immediate made possible a gradual, long adaptation to the approaching danger, but, at the same time, rendered the warnings less effective" (78).

(5) The rate at which soldiers receive fear-inducing information is an important matter. To serve a therapeutic function, anticipatory fear must be aroused without sensitizing the soldier or inducing maladaptive defense mechanisms. Janis (42) has reported the results of a series of experimental studies that bear on this issue. These studies, concerned with conditions under which fear-arousing communications tend to induce defense reactions which interfere with the acceptance of recommendations of a communication, indicate that in general the relationship between the degree of fear aroused by a communication and the acceptance of its recommendations is curvilinear:

As the level of fear is increased from zero to some minimal level, acceptance tends to increase; but as the level of fear mounts higher, there are diminishing returns; finally, when fear is very strongly aroused, psychological resistances tend to predominate and acceptance tends to decrease. (42, p. 41)

In order to keep fear levels at a minimum, it would seem desirable to provide information in a gradual and stepwise fashion.

(6) Stressful information should probably be continuously coupled with reassuring information about what one can do to protect one's self from danger or to reduce the likelihood of being harmed. Insofar as possible, stressful information should be accompanied by rules telling the soldier what he should and should not do. Unresolved aspects of the situation and information that is highly stressful should not be emphasized.

### Some Questions for the Future

Many other issues will have to be explored and many other facts will need to be established before an effective program can be developed to train a man for nuclear combat, keep his anxiety at an appropriate level during training, and prepare him to cope with the stress of battle.

Research may be needed to determine the relative stressfulness of different information in different situations; for example, information about possible protective actions might prove to be far more anxiety-inducing than anticipated. It is desirable to explore the question of whether effective levels of anticipatory fear can be induced during peacetime training; if so, under what conditions? What is an optimal mode and manner for presenting fear-inducing information? The matter of how to evaluate the effectiveness of training for "emotional inoculation" represents an extremely difficult problem. Perhaps ways can be found to study the development of anticipatory fears and their relation to the arousal of self-initiated coping mechanisms during peacetime in very restricted situations such as those employed in previous HumRRO studies of stress (9).

Questions arise regarding the possibility of keeping anxiety responses at a low level of intensity if the probability of death or injury in tactical nuclear warfare is intolerably high. It is difficult to suggest means by which such a problem can be subjected to study.

Within our culture the strong tendency to suppress thoughts and consideration of death and to exhibit mechanisms of denial when it occurs (manifested, for example, in the common funerary treatment of dead persons as if they were living<sup>1</sup>) is indicative of the fact that it is extremely difficult for us to accept death.<sup>2</sup> Therefore, it may not be possible, if the probability of death or injury in nuclear combat is extremely high, to produce a substantial reduction in denial mechanisms in exchange for more realistic expectations. What is known about stress does not suggest this as a likely possibility, but it may prove impossible to provide information about nuclear combat without sensitizing persons and inducing emotional reactions.

<sup>1</sup>Jessica Mitford, in her book, *The American Way of Death* (58), notes that even in funerals terminology connoting death has disappeared. The term

... undertaker has been supplanted by "funeral director." . . . Coffins are "caskets"; hearses are "coaches" or "professional cars"; flowers are "floral tributes"; corpses generally are "loved ones," but mortuary etiquette dictates that a specific corpse be referred to by name only—as "Mr. Jones." (pp. 18, 19)

Some caskets are equipped with foam rubber, others with innerspring mattresses; one manufacturer offers "the revolutionary 'Perfect-Posture' bed." (p. 16) Shrouds no longer exist; instead dresses, men's suits, negligees and accessories designed for corpses but appropriate for living persons are available for burial. The funeral director puts on a "well-oiled performance in which the concept of death has played no part whatsoever." (p. 77)

<sup>2</sup>While the notion of death is probably stressful in some degree among all civilized cultures, differences obviously exist. The existence of the Kamikaze pilot of World War II suggests not only that death may have a somewhat different meaning among Japanese than among Americans but that acceptance of death is probably less stressful for them than it is for us.

On the other hand, it may be that if death is almost a certainty, as for example in the case of persons who have been diagnosed as having terminal illnesses, stress is not as severe as when there is a reasonable possibility of survival. If training were designed to prepare soldiers for a situation in which death is virtually certain, the problem would be not one of coping with combat stress but rather one of finding a way to get soldiers to accept the likelihood of death, thereby reducing stress. It is perhaps unlikely, however, that this could ever be accomplished through training.

The foregoing discussion has introduced some of the issues related to the feasibility and methodology of training for stress. Research previously conducted by HumRRO has provided an initial methodology and conception upon which to base an attack on this difficult problem (9, 16, 47). Although other approaches may ultimately prove more fruitful, in general what now appears to be needed are methods for developing realistic anticipatory fears in soldiers while assuring them that they can successfully cope with dangerous situations, without at the same time so sensitizing them to danger that they are on the road to combat exhaustion before entering combat. It is obvious that at present we are only in the beginning stages of the developmental sequence necessary to design such methods, and we can only hope to provide crude formulations of how this might be accomplished.

#### BASIC ASSUMPTION AND IMPLICATIONS

The foregoing evidence is taken from a wide variety of situations involving severe stress and trauma: civil populations exposed to aerial bombing, military personnel in combat, persons involved in civil disasters, persons in concentration and POW camps, persons with terminal illnesses, mothers of children with fatal diseases, persons in mourning, and persons anticipating and recovering from major surgery. What is known of man's behavior, throughout history, indicates that man can, and in general does, hold up remarkably well under the severest forms of stress.

The evidence suggests that man is able to cope with the entire range of stress situations—even those in which he faces inevitable death. This evidence indicates that:

- (1) For some period of time, at least, men can tolerate and will continue to perform remarkably well under conditions of extreme stress.
- (2) Men fight or otherwise maintain themselves when death is likely or even inevitable.
- (3) No one can withstand stress that is indefinitely increased or indefinitely prolonged. If combat is severe enough or man remains exposed to it long enough, he is certain to suffer psychological breakdown; since individuals differ in their resistance to stress the incidence of breakdown can be expected to increase progressively with both intensity

and duration of stress. (This increase has been observed under combat conditions.)

These propositions suggest that in general man would act in tactical nuclear combat much as he has always acted in combat. Stress on the nuclear battlefield may be greater than that of conventional warfare because there is less chance of survival, or because factors such as the possibility of unknown exposure to nuclear radiation and the appearance of radiation injury and thermal burn casualties may make nuclear combat intrinsically more stressful than conventional combat. While psychological casualties might therefore increase in number, there is no evidence to suggest that there would be sharp qualitative changes in man's response to such increases in stress. The model for estimating casualty rates for psychological attrition, which is presented in the next section, is based on this assumption.

## Part II

### A MODEL FOR ESTIMATING CASUALTY RATES FOR PSYCHOLOGICAL ATTRITION

This section presents a description of a model for estimating casualty rates for psychological attrition as a function of combat during conventional warfare and warfare involving the use of tactical nuclear weapons. The discussion includes the development of the model, the assumptions on which it is based, and the sources of bias and uncertainty that need to be taken into consideration.

The model involves the adjustment of battle casualty rates to include neuropsychiatric casualties, as a function of both combat intensity and amount of time in combat. It does not take into account deterioration in combat effectiveness that may occur prior to the departure of a casualty from battle, nor does it take into account other forms of combat failure. While there is considerable evidence that deterioration does occur, there are no reliable measures of individual performance in combat upon which such estimates can be based.

#### DEVELOPMENT OF THE MODEL

The model for adjusting battle casualty rates to include NP casualties was developed from both data on NP casualties as a function of combat intensity and information on NP attrition as a function of amount of time in combat.

Two primary sources of data were used in developing the model. Information on NP casualties at different levels of combat intensity was derived from data supplied by the Medical Statistics Agency, Office of the Surgeon General. For NP attrition as a function of time in combat, information developed by Beebe and Appel (4) was used, after mathematical adjustment to allow for the fact that their data had dealt with high-risk MOS's.

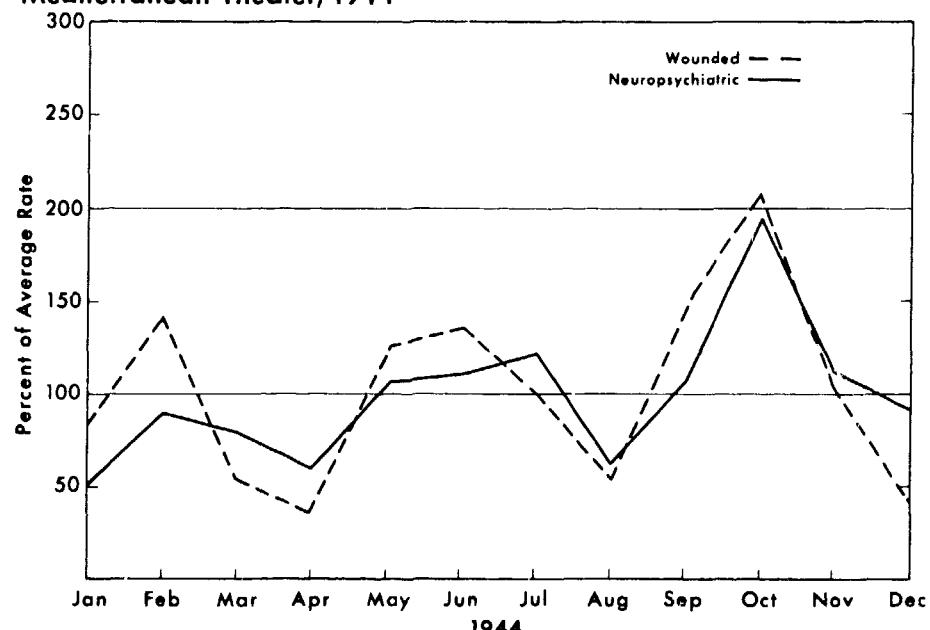
The model consists of families of curves or nomographs that provide estimates of NP rates for Infantry, Armored, and Airborne troops as a joint function of both combat intensity and time in combat.

#### Combat Intensity and NP Rate

The intensity of combat is probably best measured by the total number of casualties sustained. As indicated earlier (p. 19), a close relationship exists between intensity of combat so measured and incidence of psychological disorders. The consistent relationship between

**Relation Between Neuropsychiatric and Wounded Rates:**

**Mediterranean Theater, 1944**



Source: Beebe & DeBakey (5).

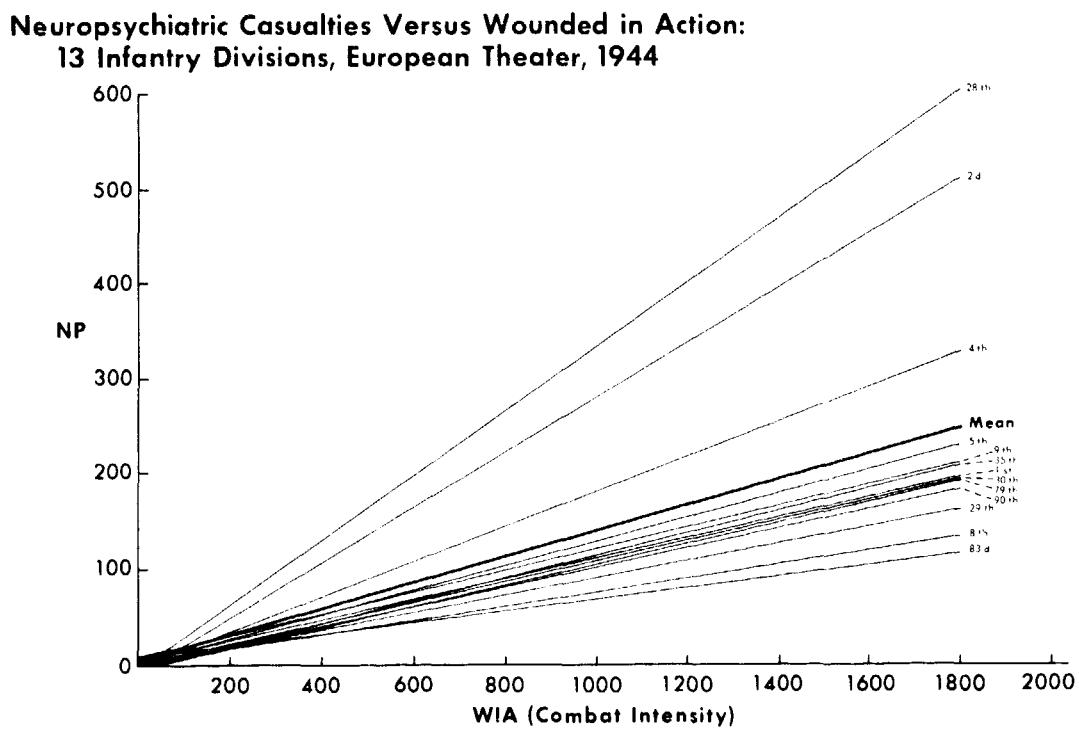
Figure 4

NP and wounded can be seen in Figure 4, which shows the relationship between rates of NP casualties and wounded, expressed as percentages of average rates, by month in the Mediterranean Theater during 1944. Similarly, the graphs in Appendix A, showing the relationship between weekly NP and WIA casualty rates for a number of Infantry, Armored, and Airborne divisions in the ETO during 1944 and 1945, indicate that NP casualties rise and fall regularly with battle casualties; these graphs show absolute numbers of casualties on separate scales.

Data used in the development of the model, as initially received from the Surgeon General's Office, included division strength, the number of men wounded in action by week, and the number of NP casualties by week separately for 42 Infantry divisions, 13 Armored divisions, and 3 Airborne divisions in the European Theater during 1944 and 1945.

The NP rate decreased in an atypical manner in the ETO as the end of hostilities began to appear imminent (4) in 1945; therefore, no data from 1945 were used in the development of the model. Also, all divisions with less than 15 weeks of combat were eliminated because in general it was felt that their exposure to combat was not sufficient to yield reliable information on NP effects. Information used in the model, relating NP rate to combat intensity, is therefore based upon data from 13 Infantry divisions, 6 Armored divisions, and 2 Airborne divisions in the ETO during 1944.

When the weekly NP casualties are plotted against the weekly wounded casualties the relationship shown in Figure 5 is evident. This figure shows curves for the 13 Infantry divisions. The slopes of the



**Figure 5**

lines represent the rate of NP casualties as a function of the number wounded, the index of combat intensity used here.<sup>1</sup>

A straight line, which has been found to be a good fit to the data, gives the expected number of NP casualties for any given level of combat intensity. The precision of the estimate is indicated by the fact that a little over two thirds of the observations fall within three casualties of the value shown. This is true up to levels of intensity of 500 wounded per division per week; beyond this point the precision decreases somewhat. This decrease is associated, to a considerable extent, with the high casualty levels sustained during the beachhead operations early in the invasion of Europe. Exactly why there is less precision is not clear, though it should be noted that the graph takes no account of variation associated with specific tactical situations or of irregularities in amount of time in combat.

Since observations beyond 500 wounded per division per week did not suggest any deviation from a straight line and the over-all accuracy of estimating the parameters of the line would be decreased by including such observations, they were not used in deriving lines of best fit. The equations for these lines and for those of the Armored and Airborne divisions shown next are presented in Appendix B.

A plot for the six Armored divisions is shown in Figure 6. It should be noted that the slopes are steeper than in the Infantry divisions. In addition, Armored troops in general incur a higher rate of NP

<sup>4</sup>The evident skewness of the distribution might suggest that a median would be a better estimate of central tendency than the mean actually used. On the basis of advice from military experts, the mean was chosen as being a more realistic estimate for Infantry divisions.

casualties at any given level of battle intensity. The 4th Armored division, for example, had about three NP casualties for every four men wounded at its average level of battle intensity.

**Neuropsychiatric Casualties Versus Wounded in Action:  
Six Armored Divisions, European Theater, 1944**

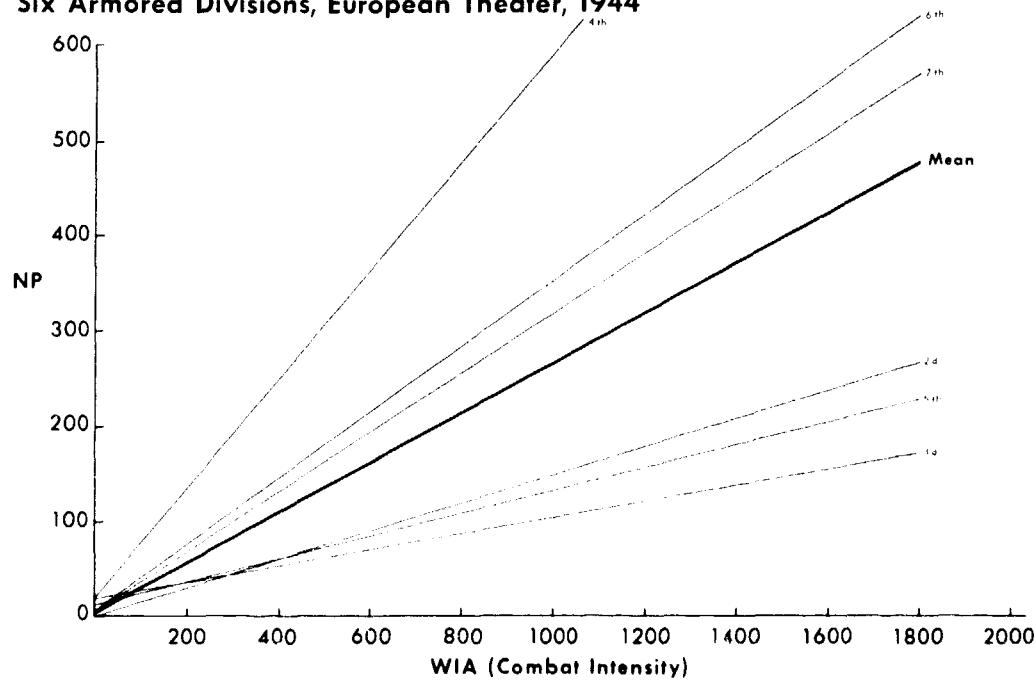


Figure 6

**Neuropsychiatric Casualties Versus Wounded in Action:  
Two Airborne Divisions, European Theater, 1944**

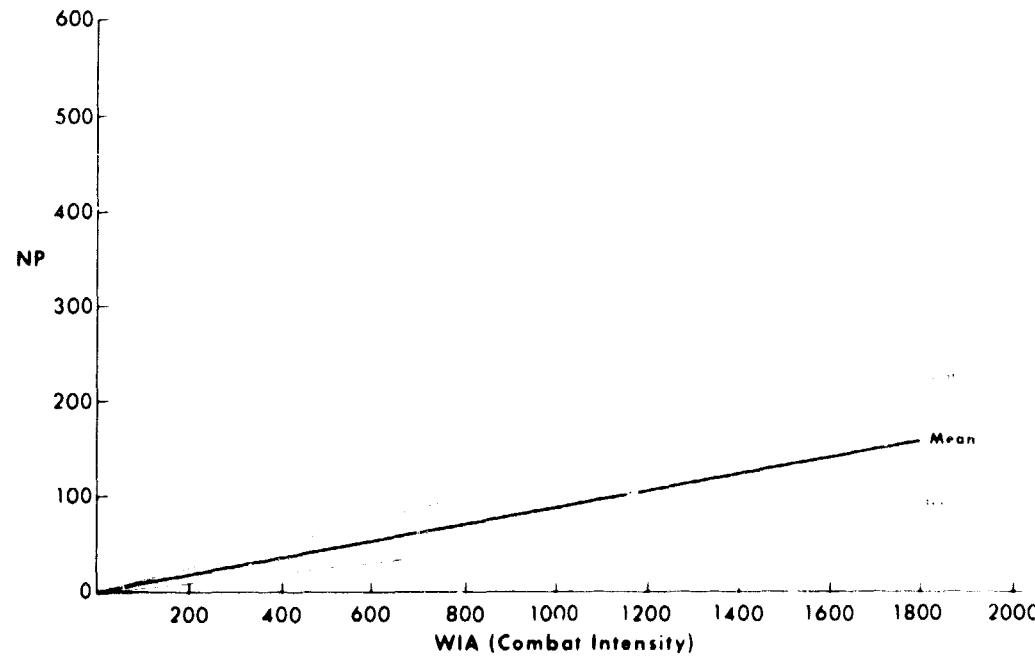


Figure 7

A similar graph for the two Airborne divisions is shown in Figure 7. The slopes for these divisions are in general less than those of the Infantry divisions. Also, Airborne troops show a somewhat lower NP rate.

A comparison of the mean slope for each type of unit is shown in Figure 8. At average combat intensity for Infantry divisions (250 WIA per week) the ratio of NP to wounded is about 1 to 6. For comparable levels of intensity the ratio of NP to wounded is about 1 to 3 in Armor and 1 to 10 in Airborne.

#### **Neuropsychiatric Casualties Versus Wounded in Action: Mean Value, European Theater, 1944**

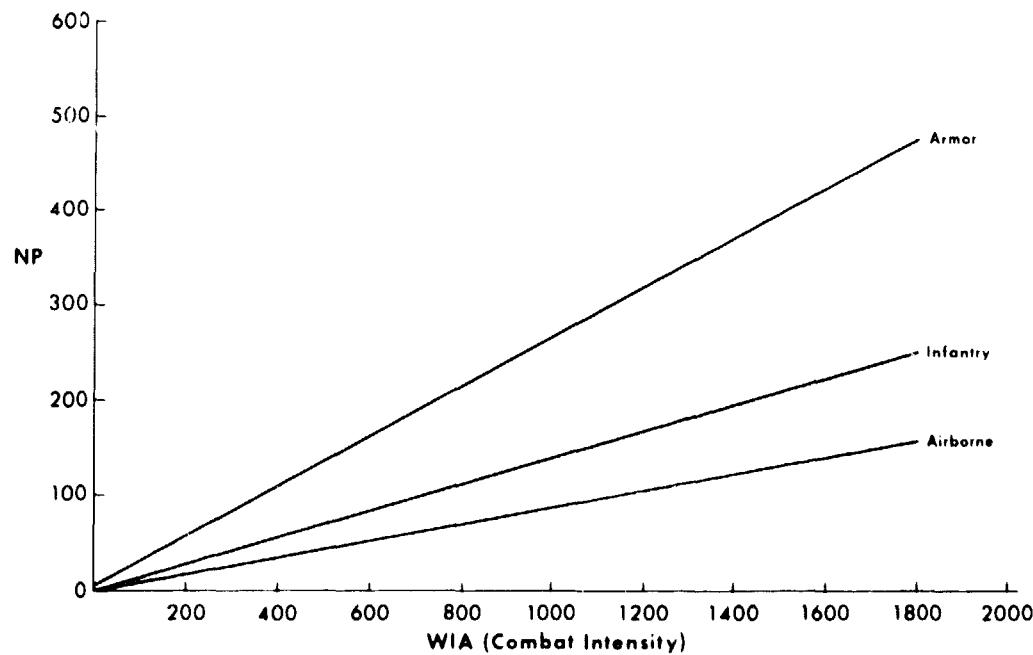


Figure 8

Since Infantry, Armored, and Airborne troops show distinctly different NP rates as a function of combat intensity, it was deemed appropriate to develop separate models or nomographs.

#### Cumulative Effects of Combat and NP Rate

As discussed earlier, the most important factor affecting the frequency of psychological disorders and the rate at which NP casualties occur may be termed cumulative combat stress, which arises primarily as a function of the duration of a man's exposure to the stress of battle.

Estimating NP Rates in Terms of Time in Combat. The study by Beebe and Appel (4), described previously (p. 21), provides quantitative information on the relationship between the incidence of psychiatric casualties and cumulative time in combat. Beebe and Appel were concerned specifically with the psychiatric attrition of infantrymen in high-risk MOS's. The composition of the high-risk sample in their study, indicating the number of men in each MOS and the combat risk

for each MOS relative to an average division risk of 100, is shown in Table 2.

Table 2  
Composition of the High-Risk Sample<sup>a</sup>

Number	MOS-Specification Serial Number	Relative Risk
80	Ammunition Handler - 504	132
65	Gunner - 603 Light Machine Gunner - 604 Heavy Machine Gunner - 605 Light Mortar Crewman - 607	134
29	Platoon Sergeant - 651	155
14	Section Leader - 652	151
181	Squad Leader - 653	212
530	Rifleman - 745	432
101	Automatic Rifleman - 746	280
1,000		

<sup>a</sup>After: Beebe and Appel (4).

An estimate of NP attrition as a function of cumulative exposure to combat for an average infantry soldier (i.e., a weighted composite of all men in an Infantry division) can be obtained by adjusting the findings of Beebe and Appel, taking other information into consideration as follows:

- (1) Using information derived from the Surgeon General's data on the rate of NP casualties in an average Infantry division as a function of the number wounded (the slope of the mean line in Fig. 5).
- (2) Transforming this information to show the NP casualty rate as a function of total battle casualties.<sup>1</sup>
- (3) Using information derived from the Surgeon General's data on the average number of battle casualties for an average Infantry division.
- (4) Using the information provided by Beebe and Appel on the likelihood of men in high-risk Infantry MOS's becoming battle casualties relative to average Infantry soldiers becoming battle casualties.

For the present study the NP casualty rates from Beebe and Appel were adjusted in this manner.<sup>2</sup> These adjusted figures can be generalized with safety if, as seems reasonable, (1) the Beebe and Appel data subsume the entire range of intensity of conventional combat, (2) time in combat in the data obtained from the Surgeon General is equivalent to that of the Beebe and Appel sample, and (3) the relationship

<sup>1</sup>This transformation is made on the basis of the WIA/KIA ratio of 4.1 to 1 for Infantry troops during World War II (Beebe and DeBakey, 5).

<sup>2</sup>See Appendix C for computational procedures.

between battle and NP casualty rates is linear, within the Beebe and Appel data, as in the Surgeon General's data.

NP attrition rates for average Infantry soldiers as a result of cumulative time in combat are shown in Table 3. While the NP rate rises as a function of time in combat, the rate of increase becomes less rapid with the passage of time. To provide approximately equal changes in departure rates, such rates are shown for increasingly longer intervals of combat exposure.

Table 3

**Estimated Psychiatric Attrition Rates  
for Infantry Soldiers as a Result  
of Cumulative Time in Combat<sup>a</sup>**

Cumulative Days of Combat	NP Rate per 1,000 Men per 10-day Period
1-5	5.81
6-10	20.36
11-20	42.20
21-40	66.75
41-80	88.91

<sup>a</sup>Adjusted from Beebe and Appel (4) rates in Table 1.

Combined Effects of Combat Intensity and Time in Combat on NP Rate Among Infantry Troops. The best over-all estimate of NP casualties for Infantry troops solely as a function of combat intensity, at any given level of intensity, is obtained from the NP casualty rate for an average Infantry division as a function of total battle casualties (see previous section). This figure, based on troops with all degrees of combat exposure, indicates the NP rate for troops with average combat exposure.

The best over-all estimate of NP casualties for Infantry troops solely as a function of cumulative exposure to combat, at different degrees of combat exposure, is given in the adjusted Beebe and Appel rates. These figures, based on troops fighting at all degrees of combat intensity, indicate estimated NP casualties for troops at average combat intensity. Average combat intensity for Infantry troops can be estimated from the Surgeon General's data.

Assuming that the NP casualty rate, as given by the adjusted Beebe and Appel figures, occurs at average combat intensity, and using the function relating combat intensity to NP makes it possible to generate a family of curves showing NP casualties among troops with different amounts of combat exposure, as a function of different levels of combat intensity.<sup>1</sup>

This nomograph is shown in Figure 9. The scales are given in terms of numbers of casualties per 1,000 men per day. Graphs for units of other sizes and for time intervals can readily be prepared. In

<sup>1</sup>See Appendix D for computational procedures and equations.

**Neuropsychiatric Casualties Among Infantry Troops  
as a Function of Combat Intensity, by Cumulative Time in Combat  
(Per Thousand Men per Day)**

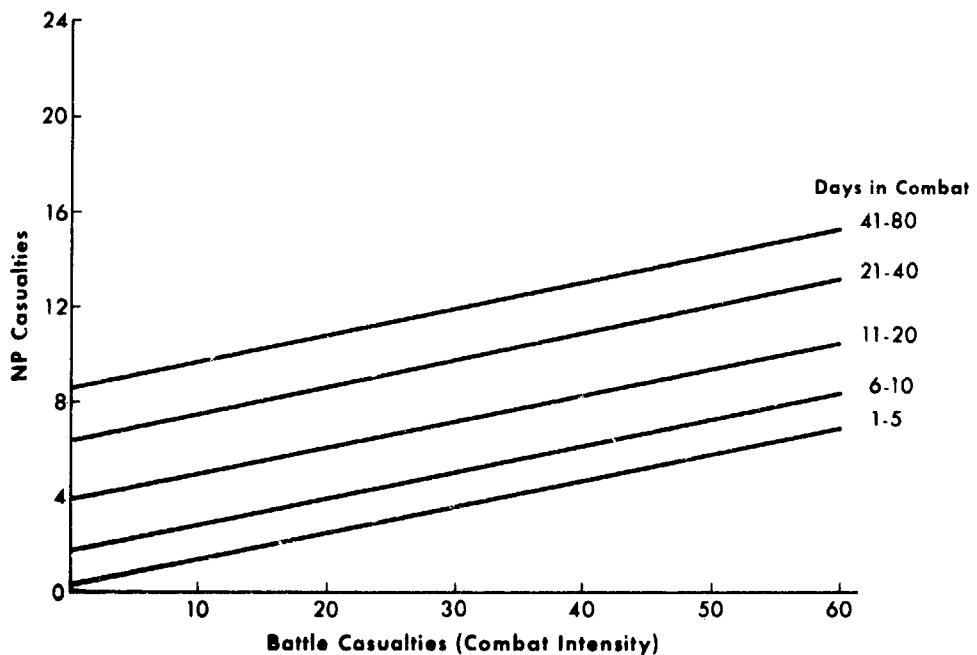


Figure 9

using the nomograph the point of intersection of a given number of battle casualties and the appropriate time line is located; the NP estimate is then read off the ordinate. For example, for soldiers who have been in combat for 11 to 20 days, a group of 1,000 troops who have sustained 25 battle casualties would be expected to show 6.7 NP casualties. Nomographs provided in Figures 9, 10, and 11 are intended primarily for descriptive purposes; to obtain precise NP estimates, the equations in Appendices D, E, and F should be used.

As indicated earlier, there is somewhat greater variability in the data upon which the model is based at high levels of combat intensity. This loss in precision does not appear to be critical, since, in such instances, the absolute number of casualties is large and the percent error is likely to be comparable to that of lower intensity estimates.

Combined Effects of Combat Intensity and Time in Combat on NP Rate Among Armored and Airborne Troops. Essentially the same procedure was followed in generating families of curves for Armored and Airborne troops, substituting the average Armored division slope (Fig. 6) and the average Airborne division slope (Fig. 7) as appropriate. However, since the adjusted data of Beebe and Appel are based on Infantry troops and information derived from the Surgeon General's data indicates considerable differences in frequency of NP casualties among the three types of units, it was felt that an adjustment was necessary for Armored and for Airborne troops. These adjustments, raising the level of Armored NP casualties above that of Infantry, and lowering the level of Airborne NP casualties below Infantry, were based on derivations

from the Surgeon General's data showing NP casualty rates at the point where there are no battle casualties.<sup>1,2</sup>

The Armor nomograph is shown in Figure 10 and the Airborne nomograph is shown in Figure 11. Equations for Armor and Airborne curves are given in Appendices E and F, respectively.

### Neuropsychiatric Casualties Among Armored Troops as a Function of Combat Intensity, by Cumulative Time in Combat (Per Thousand Men per Day)

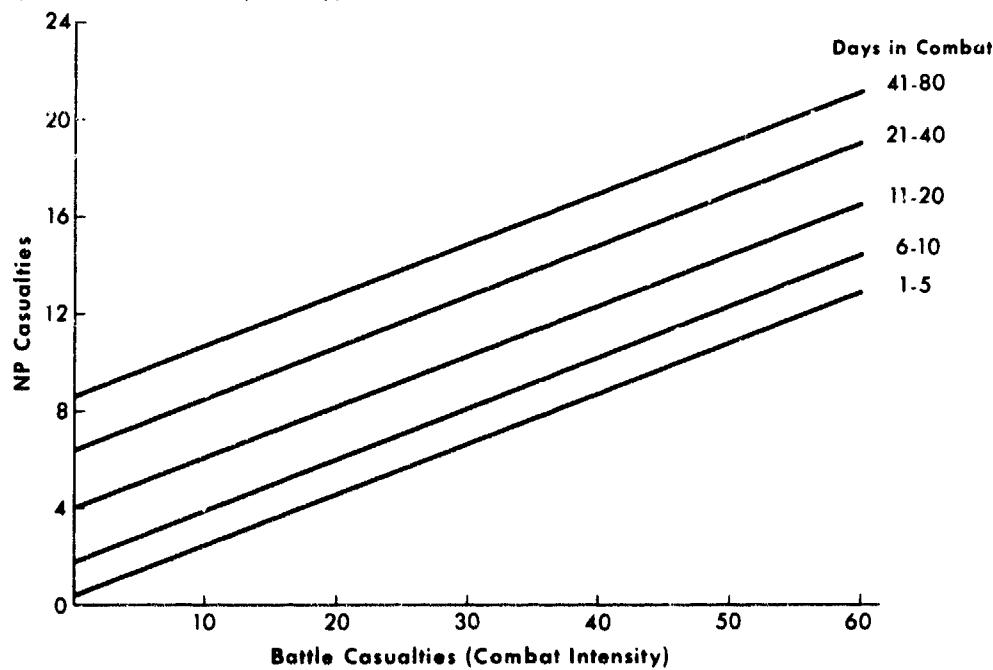


Figure 10

### ADEQUACY OF THE MODEL AND ITS APPLICABILITY TO TACTICAL NUCLEAR COMBAT

This model describes the relationship between intensity and duration of combat and NP casualty levels experienced during World War II. Used to predict psychiatric casualties during conventional land warfare, this model will provide NP rate estimates that are conservative, primarily because NP casualty statistics are, in general underestimates of the true incidence (1, 33, 53, 79, February 1953).<sup>3</sup>

<sup>1</sup>This point seemed to be the most conservative since the curves diverge with increasing combat intensity (see Fig. 8).

<sup>2</sup>See Appendices E and F for computational procedures.

<sup>3</sup>The model is *not* designed to estimate the over-all combat effectiveness of groups of soldiers. If used for this purpose, it would produce gross overestimates, since the model takes into account neither deterioration in a man's performance prior to his leaving battle as a psychiatric casualty, nor other forms of combat failure due completely or in part to psychological factors.

**Neuropsychiatric Casualties Among Airborne Troops  
as a Function of Combat Intensity, by Cumulative Time in Combat  
(Per Thousand Men per Day)**

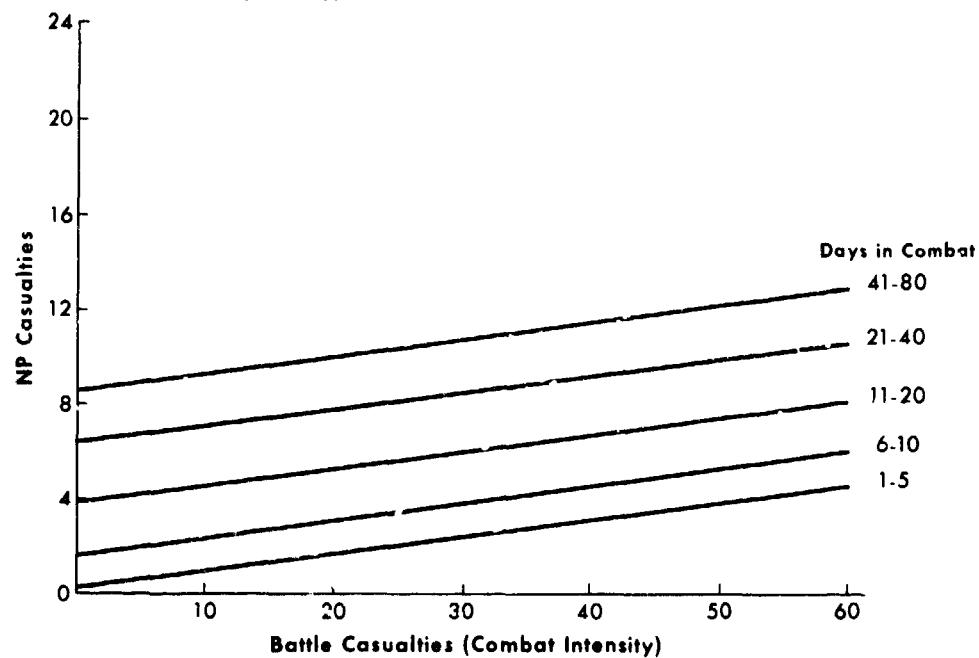


Figure 11

Reasons for underestimates of NP casualties include the following:

(1) Divisions and other Army units differed during World War II with regard to the availability of psychiatrists and other medical officers equipped to recognize and diagnose psychiatric disorders; as a result, some NP casualties were overlooked or classified otherwise.

(2) In some situations standardized procedures for the evacuation, treatment, and reporting of casualties could not be established, as in combat involving relatively small groups of men on islands in the Southwest Pacific. In such instances, reports of NP casualties were likely to be incomplete and in some instances quite unreliable.

(3) As a matter of policy and for a variety of administrative reasons, NP disorders sometimes were not reported as such.

(4) Instances of secondary NP diagnosis are typically excluded from tabulations of NP casualties; that is, where a soldier is both a battle and an NP casualty or where he has been hospitalized for other causes and is later diagnosed, in addition, as having a psychiatric disorder, he is frequently omitted from NP statistics.

Combat stress undoubtedly increases with combat intensity in some fashion. Combat intensity is reasonably indicated by the number of casualties. It is on this premise that we move to a consideration of stress.

Whether a model based on the experiences of conventional land warfare may be used to predict NP rates in tactical nuclear war is, as yet, an open question. Using the model for this purpose rests in part on the assumption that, while stress on the tactical nuclear

battlefield may be greater than that of the past and psychological casualties may increase in number, there will be no sharp qualitative changes in man's response to such increases in stress.

As indicated earlier, evidence suggests that in general man will act in nuclear combat much as he has always acted in combat. Thus the application of a model which predicts psychiatric casualties as a function of current and cumulative stress in battle is not unreasonable.

The model is based on the experiences of World War II in which the ratio of wounded to killed among Infantry troops was 4.1 to 1. In tactical nuclear combat this ratio would probably differ, depending on such factors as the yields of the weapons used, burst heights employed, environmental protection, and mode of troop deployment. In addition, there would be new forms of casualties not encountered in conventional warfare, that is, radiation and thermal injuries. It is not known whether these factors would make nuclear warfare more or less stressful than conventional warfare if total battle casualties were comparable.

Battle casualties sustained may provide an adequate index of the stress of nuclear battle, or nuclear battle may be stressful in a degree far beyond that indicated by casualty levels. It is not credible, however, that nuclear battle would be less stressful than indicated by its own casualty rates.

It is likely, therefore, that the estimates of stressfulness used in the model are conservative. Depending on whether these estimates are in general correct, the model adjusts for either all of the psychiatric casualties or some of the psychiatric casualties. On all counts, using the model will result in conservative corrections rather than over-estimates of probable NP casualties. Such corrections, although conservative, can still have considerable impact on over-all casualty figures.

**REFERENCES  
AND  
APPENDICES**

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## ACKNOWLEDGMENTS

Permission of the following journals or publishers to use copyrighted material from the indicated publications is gratefully acknowledged.

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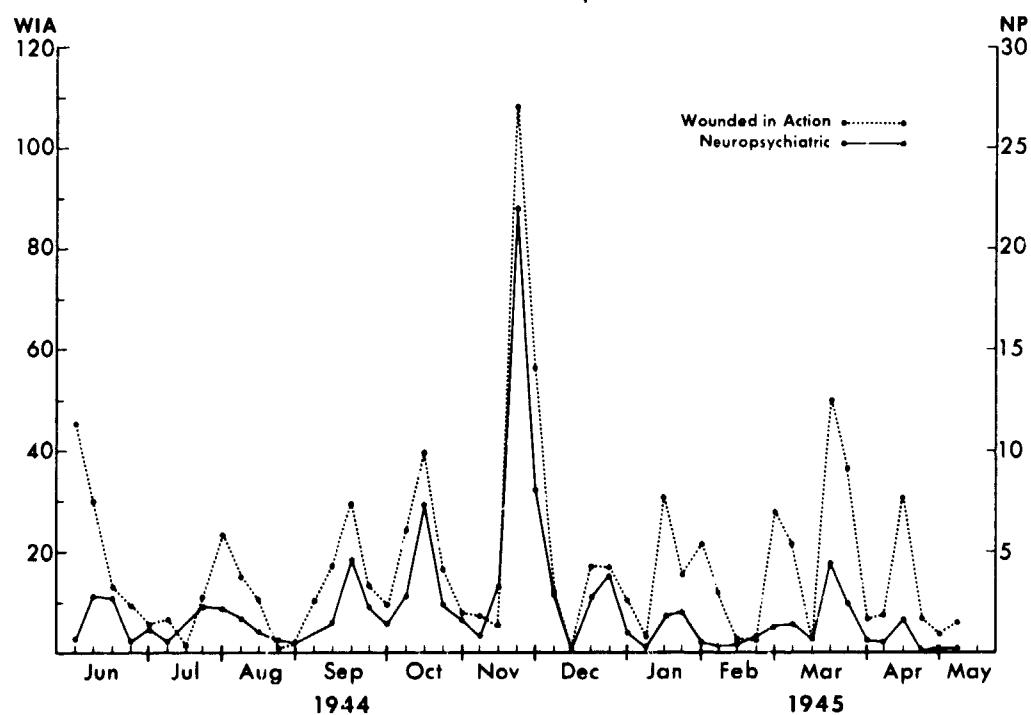
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## Appendix A

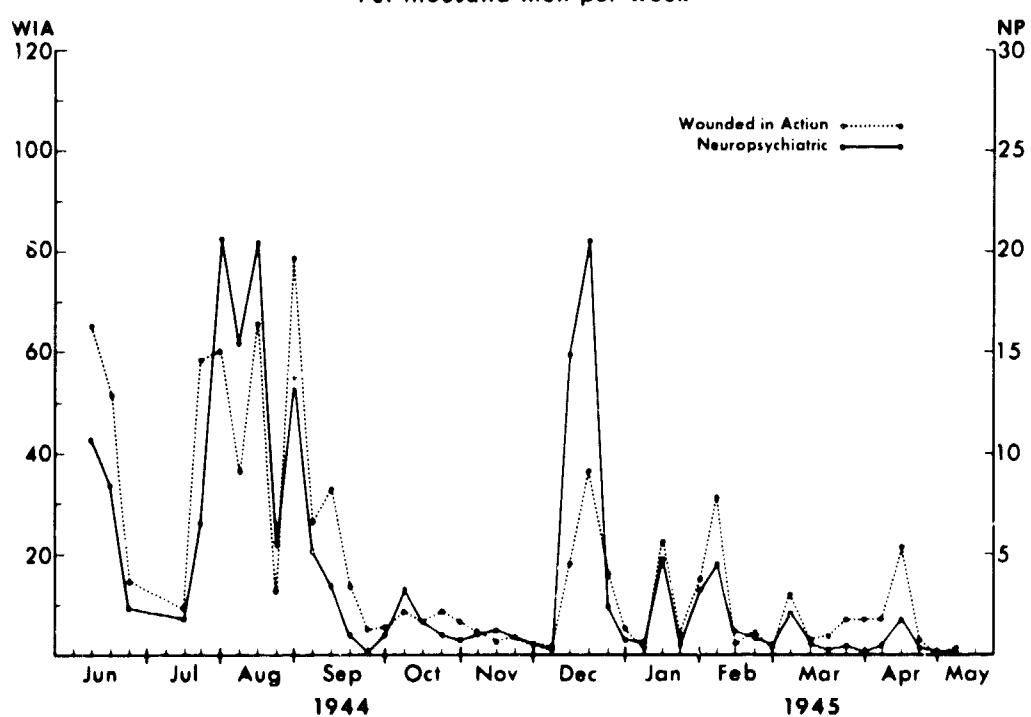
### **Neuropsychiatric (NP) and Wounded in Action (WIA) Casualty Rates for 10 Infantry Divisions, 6 Armored Divisions, and 1 Airborne Division in European Theater of Operations During 1944-45**

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WIA and NP Casualties: 4th Infantry Division . . . . .	77
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**WIA and NP Casualties: 1st Infantry Division**  
Per thousand men per week

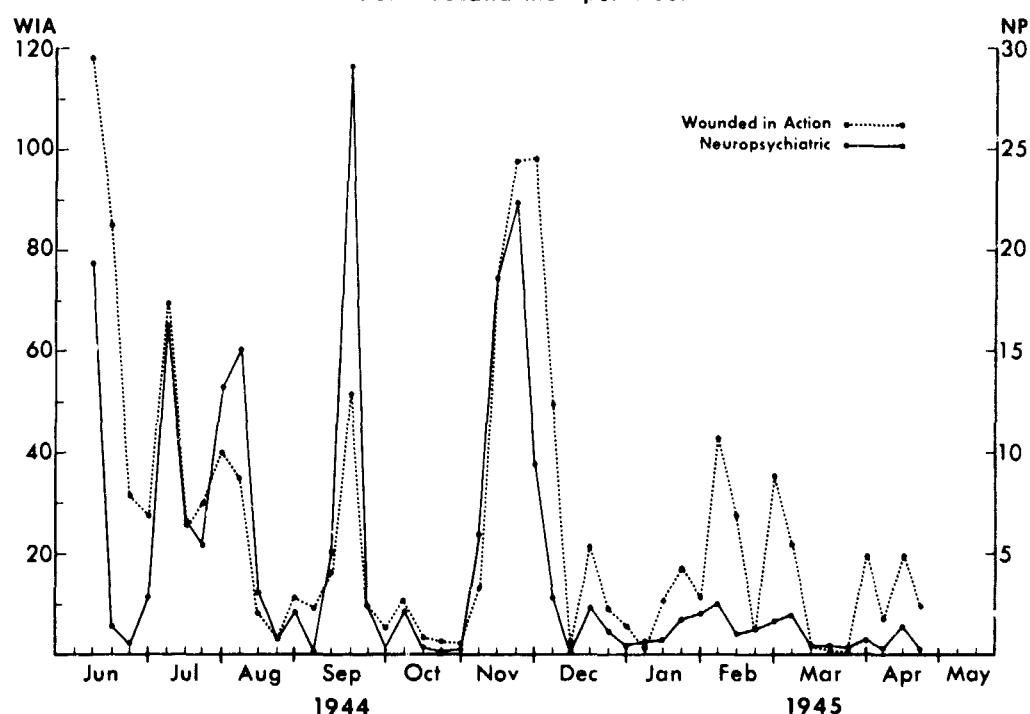


**WIA and NP Casualties: 2d Infantry Division**  
Per thousand men per week



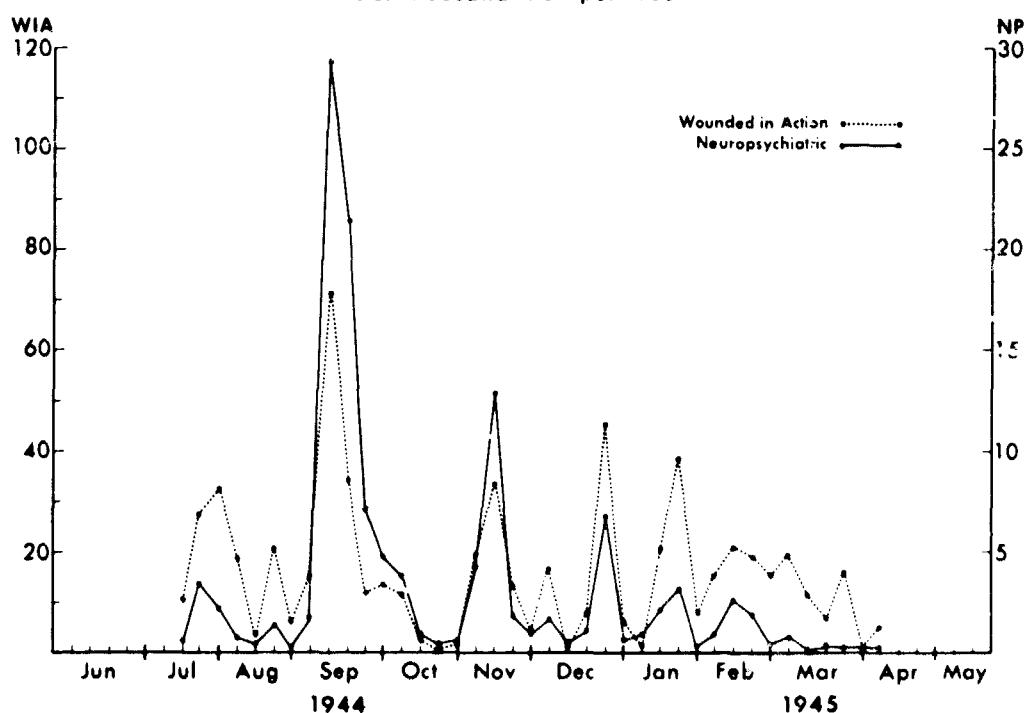
### WIA and NP Casualties: 4th Infantry Division

Per thousand men per week



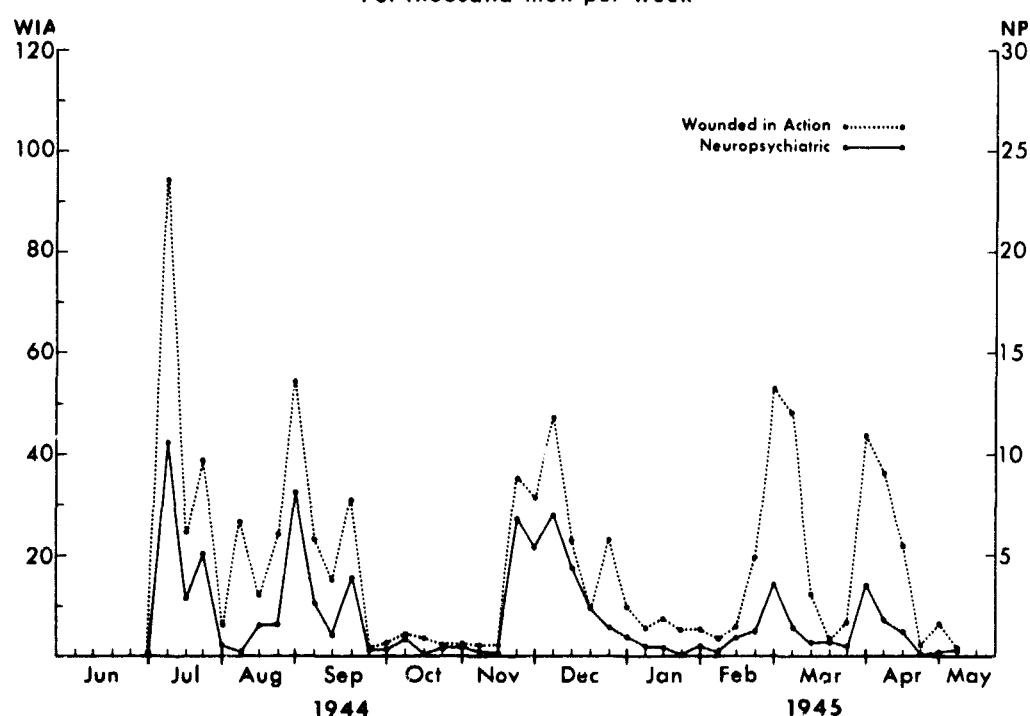
### WIA and NP Casualties: 5th Infantry Division

Per thousand men per week



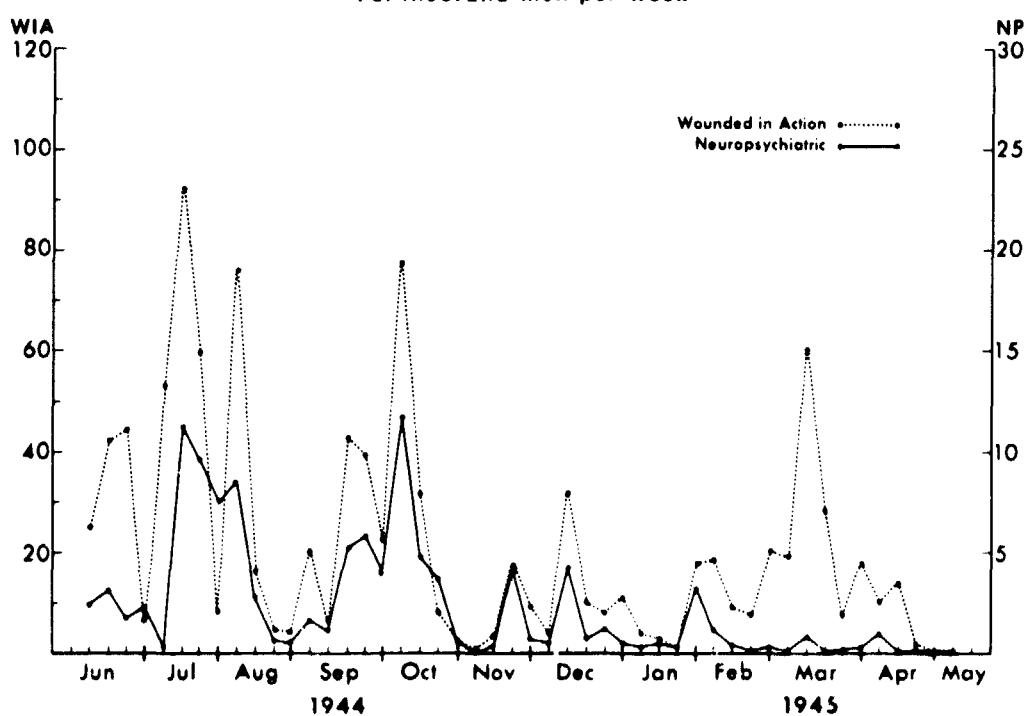
### WIA and NP Casualties: 8th Infantry Division

Per thousand men per week



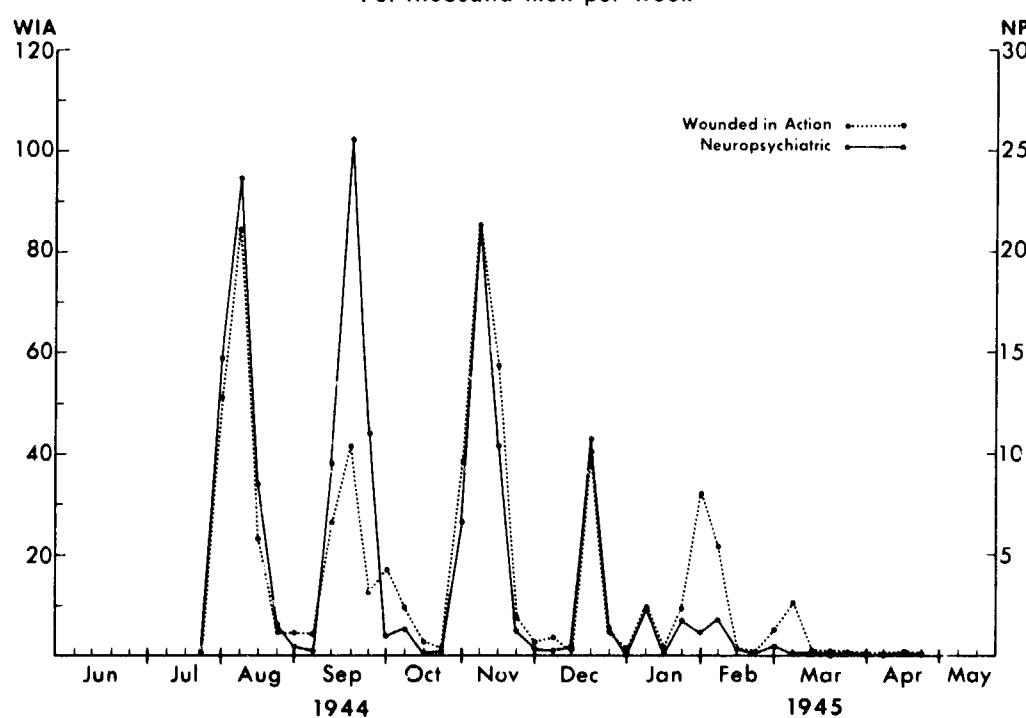
### WIA and NP Casualties: 9th Infantry Division

Per thousand men per week



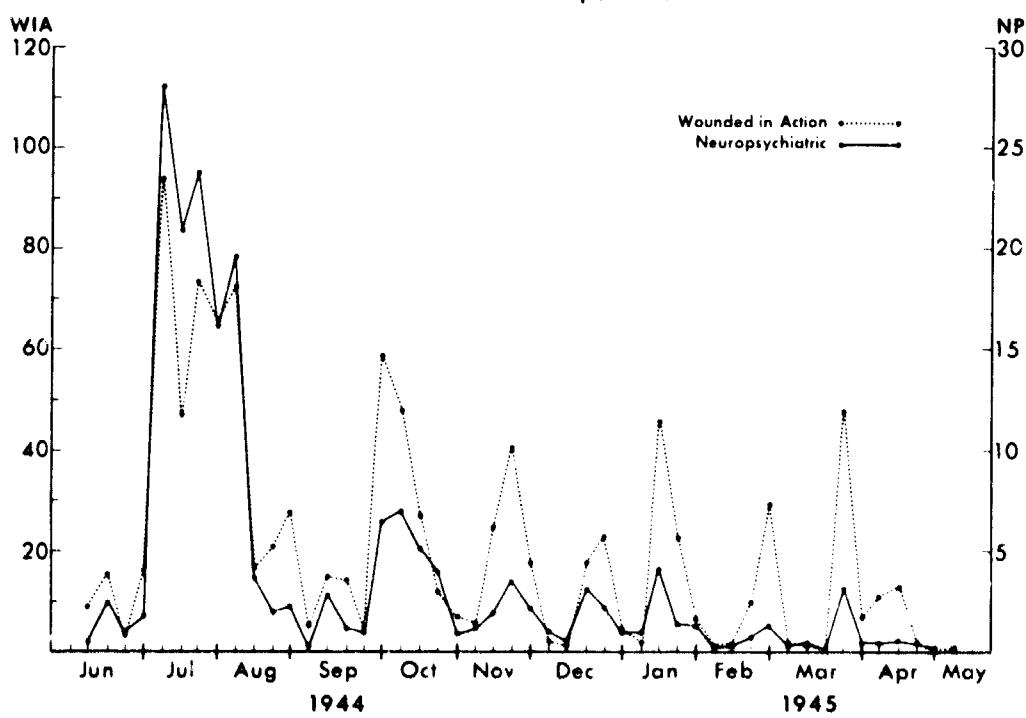
### WIA and NP Casualties: 28th Infantry Division

Per thousand men per week



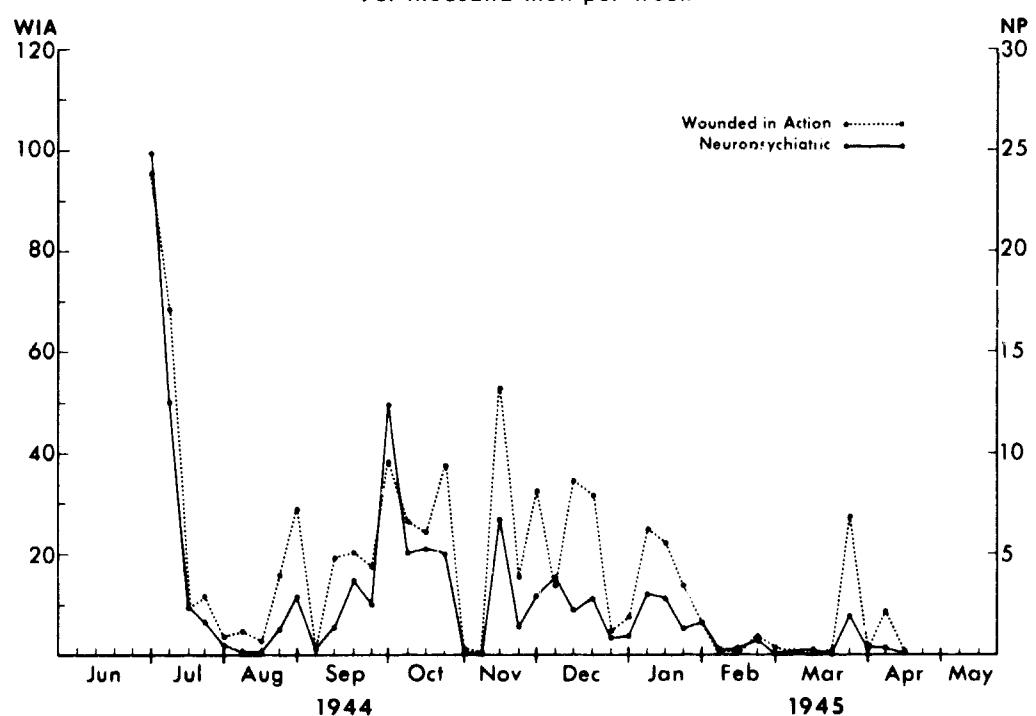
### WIA and NP Casualties: 30th Infantry Division

Per thousand men per week



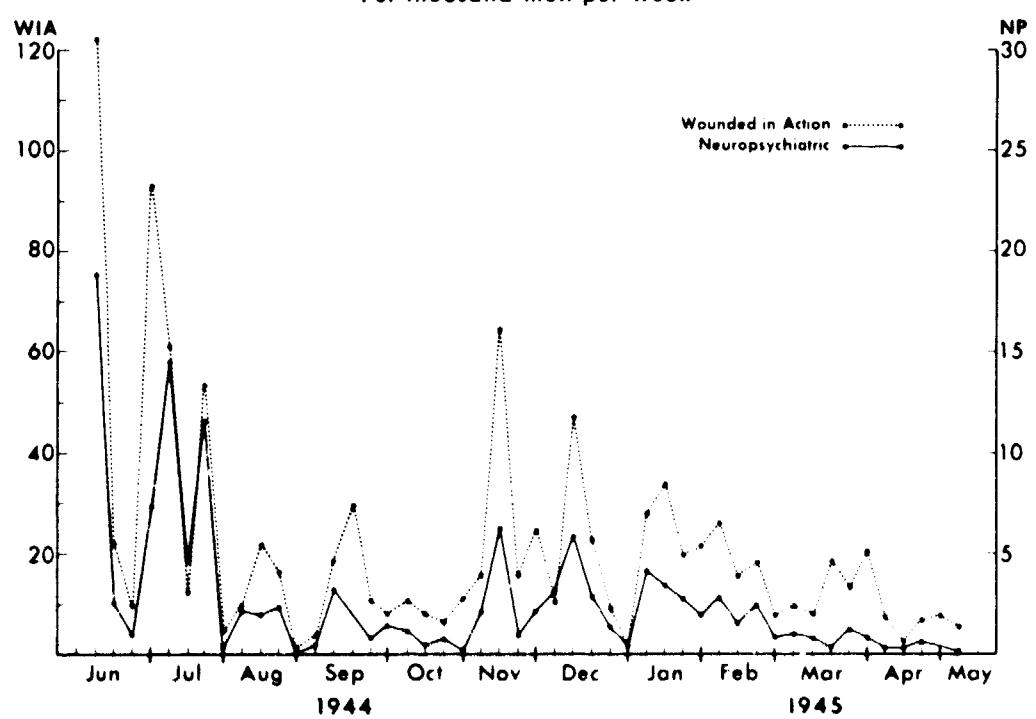
### WIA and NP Casualties: 79th Infantry Division

Per thousand men per week



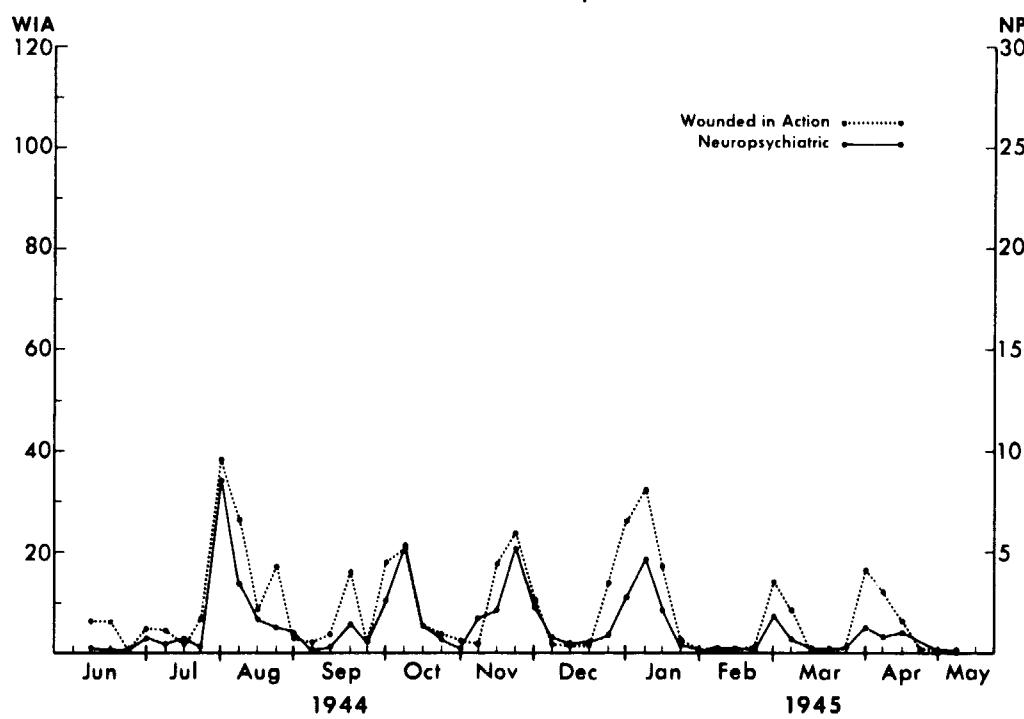
### WIA and NP Casualties: 90th Infantry Division

Per thousand men per week



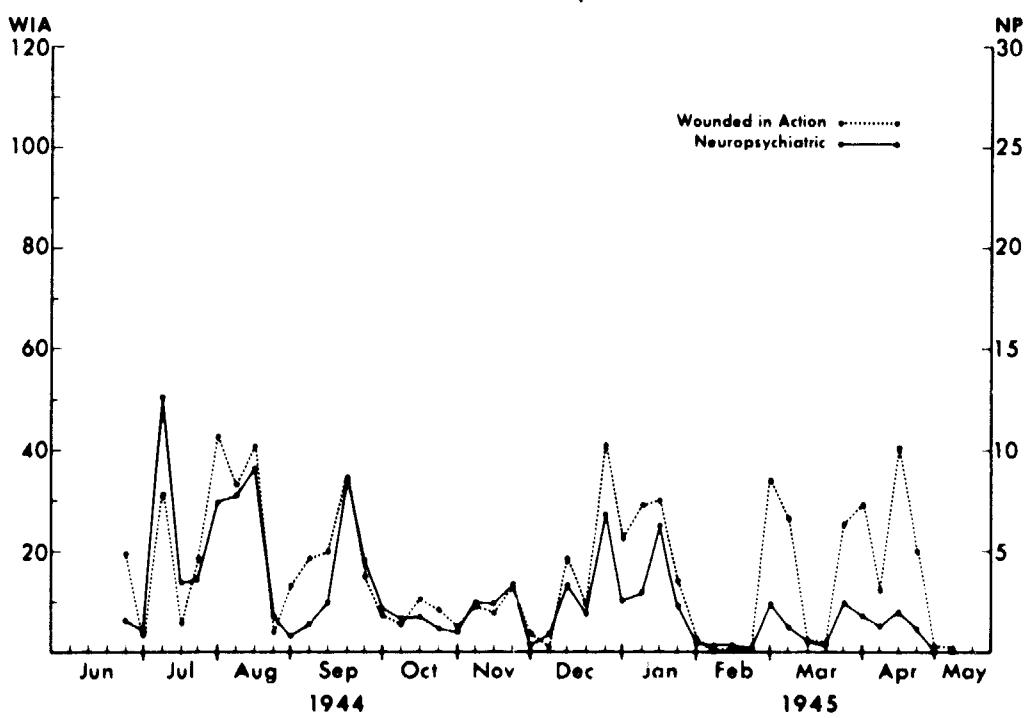
### WIA and NP Casualties: 2d Armored Division

Per thousand men per week



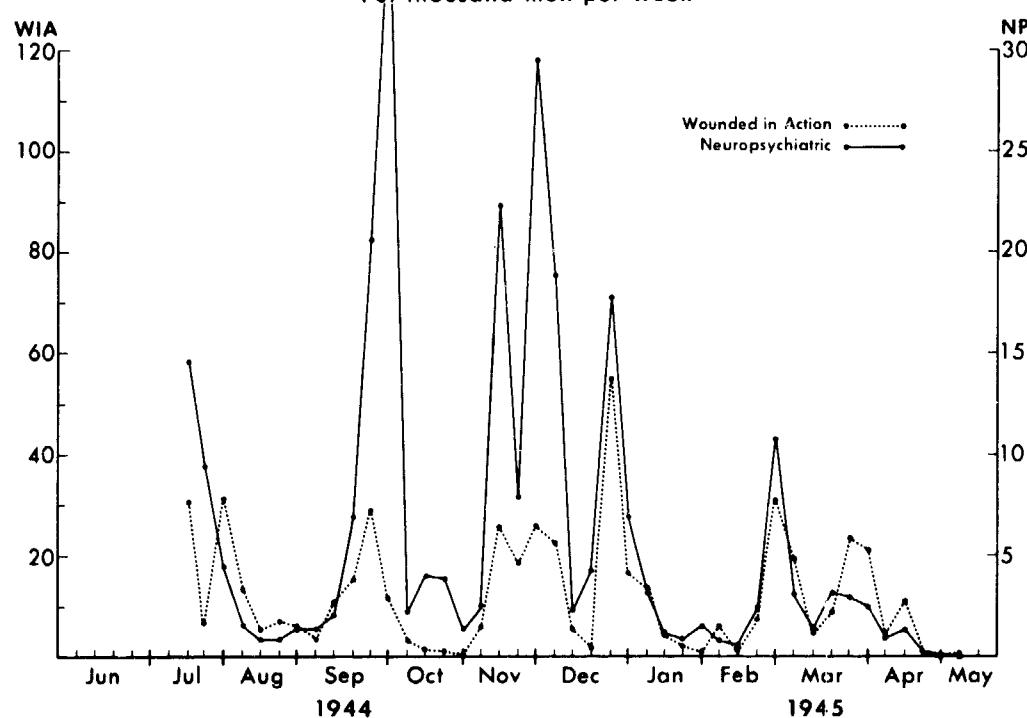
### WIA and NP Casualties: 3d Armored Division

Per thousand men per week



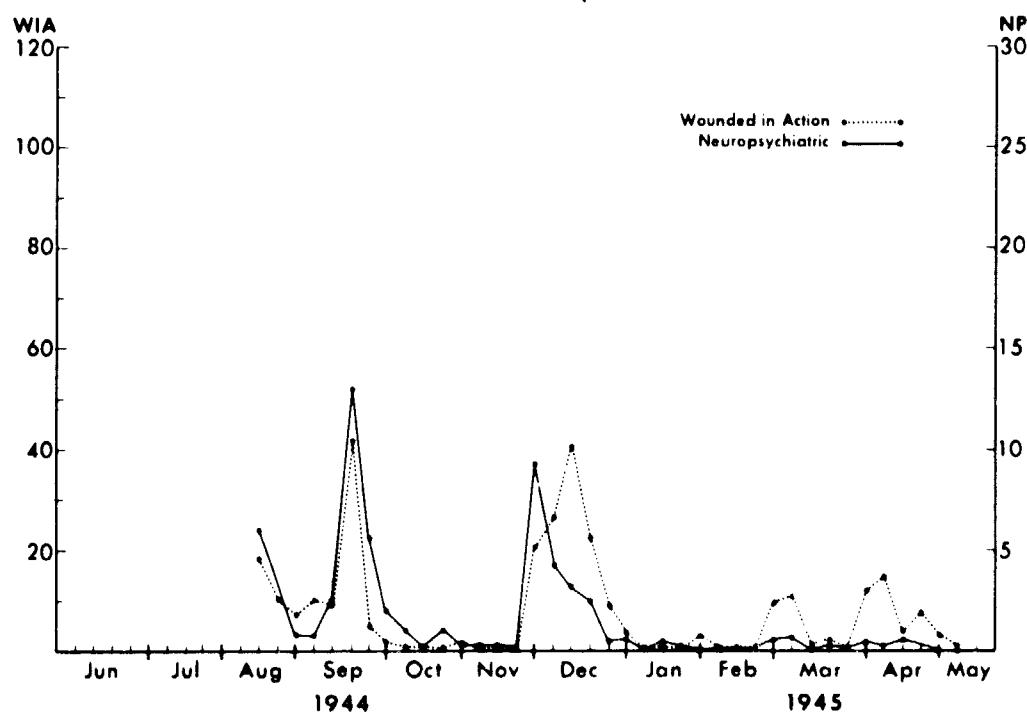
### WIA and NP Casualties: 4th Armored Division

Per thousand men per week



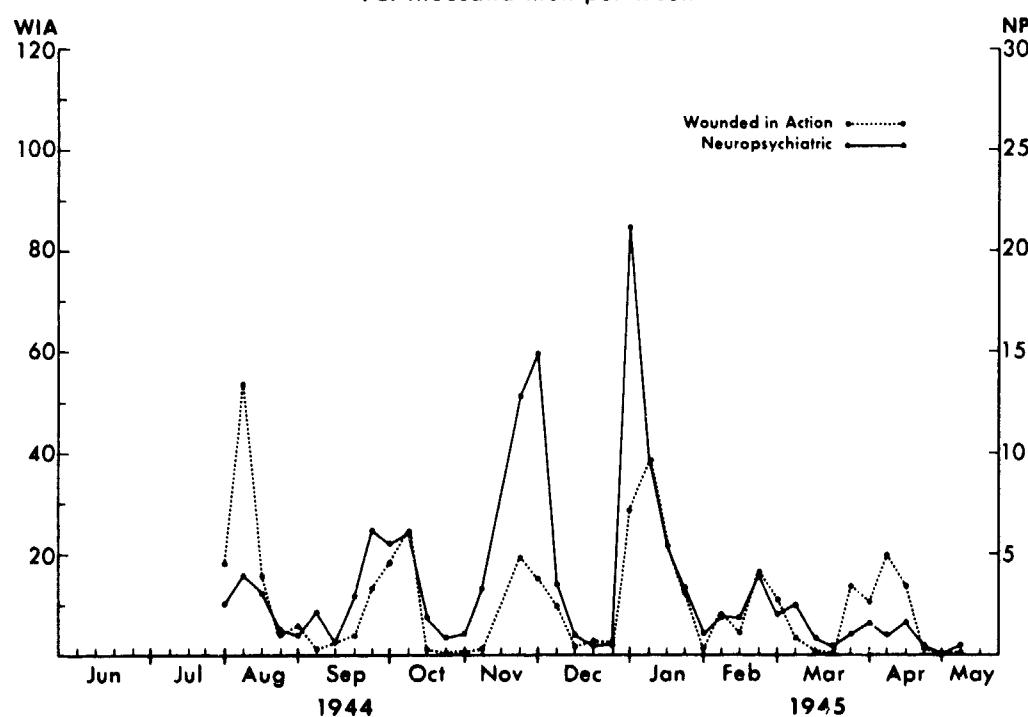
### WIA and NP Casualties: 5th Armored Division

Per thousand men per week



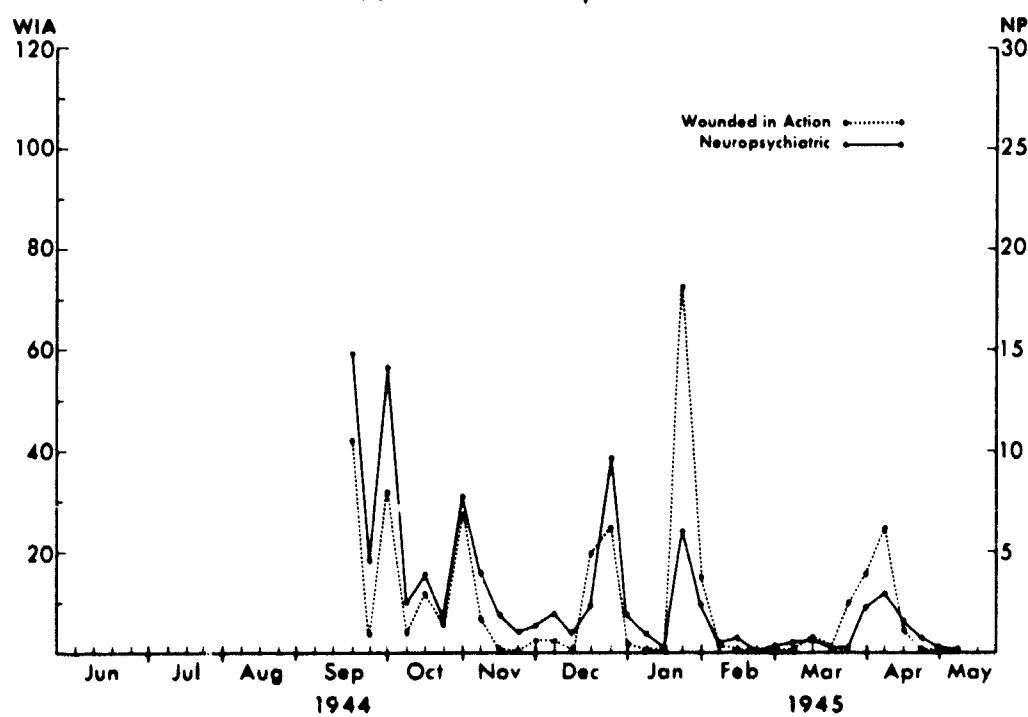
### WIA and NP Casualties: 6th Armored Division

Per thousand men per week



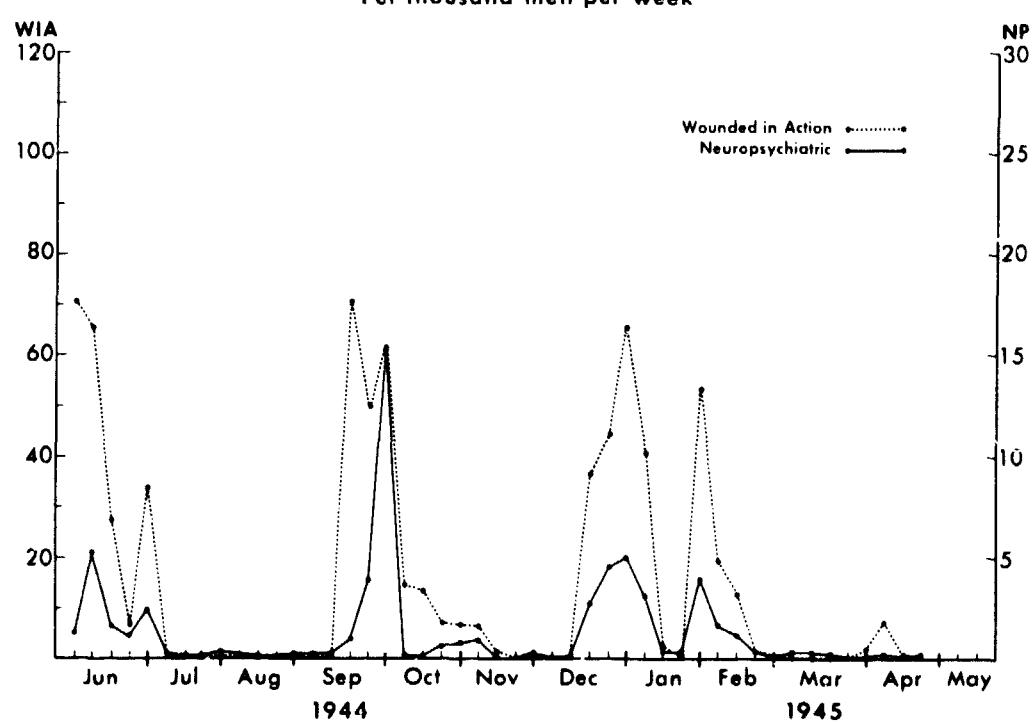
### WIA and NP Casualties: 7th Armored Division

Per thousand men per week



### WIA and NP Casualties: 82d Airborne Division

Per thousand men per week



## Appendix B

### Equations for Lines Best Fitting (Least Squares) Plots of NP Casualties Versus WIA Casualties for 13 Infantry Divisions, 6 Armored Divisions, and 2 Airborne Divisions in Europe During 1944<sup>1</sup>

$x$  = WIA casualties  
 $y$  = NP casualties

<u>Division</u>	<u>Equation</u>
<b>Infantry</b>	
1st	$y = .10 x + 10.2$
2d	$y = .29 x - 6.0$
4th	$y = .18 x + 2.4$
5th	$y = .12 x + 9.8$
8th	$y = .07 x + 4.5$
9th	$y = .11 x + 12.8$
28th	$y = .34 x - 7.7$
29th	$y = .09 x + 3.8$
30th	$y = .10 x + 9.3$
35th	$y = .11 x + 2.7$
79th	$y = .11 x + 5.1$
83rd	$y = .06 x + 5.6$
90th	$y = .14 x + 4.5$
Mean Infantry Division	$y = .14 x + 4.5$
<b>Armored</b>	
2d	$y = .15 x + 1.1$
3d	$y = .08 x + 17.8$
4th	$y = .57 x + 20.2$
5th	$y = .12 x + 12.1$
6th	$y = .35 x + 9.8$
7th	$y = .31 x + 9.0$
Mean Armored Division	$y = .26 x + 11.7$
<b>Airborne</b>	
82d	$y = .05 x + 2.6$
101st	$y = .13 x + 1.1$
Mean Airborne Division	$y = .09 x + 1.8$

<sup>1</sup>From Surgeon General's data.

## Appendix C

### Computational Procedures for Adjusting Beebe and Appel Rates to Provide Estimated Psychiatric Attrition Rates for Infantry Soldiers as a Result of Cumulative Time in Combat

#### Beebe and Appel (4) High-Risk Sample

<u>MOS</u>	<u>N</u>	<u>Relative Risk</u>		
Ammunition Handler	80	X	132	= 10560
Gunner				
Light Machine Gunner	65	X	134	= 8710
Heavy Machine Gunner				
Light Mortar Crewman				
Platoon Sergeant	29	X	155	= 4495
Section Leader	14	X	151	= 2114
Squad Leader	181	X	212	= 28372
Rifleman	530	X	432	= 228960
Automatic Rifleman	101	X	280	= 28280
	<u>1000</u>			<u>321491</u>
				<u>321491</u> 1000 = 321

Relative combat risk for  
Beebe and Appel sample where  
average division risk is 100 = 321

#### Derivation of Formula for Adjusting Beebe and Appel NP Rate

Where:

- NP = Beebe and Appel NP attrition rate per 1000 men per 10-day interval
- NP' = Adjusted NP attrition rate per 1000 men per 10-day interval in an Infantry division
- m = Rate of NP casualties as a function of number wounded in action - (Appendix B)
- m' = Adjusted NP rate as a function of total battle casualties
- c = Average number of battle casualties per 1000 Infantry soldiers per 10-day interval (from Surgeon General's data) = 27.75

$\frac{321}{100}$  = Relative risk of Beebe and Appel sample  
to average Infantry division risk

To adjust slope for total battle casualties:

$$m' = \frac{4.1}{5.1} m$$

$$m' = \frac{4.1}{5.1} (.14)$$

$$m' = .11$$

To adjust Beebe and Appel rate:

$$NP = m' c \frac{321}{100} + I$$

$$NP' = m' c + I$$

$$\frac{NP'}{NP} = 1 - \frac{221 m' c}{100 NP}$$

$$\frac{NP'}{NP} = 1 - \frac{(221) (.11) (27.75)}{100 NP}$$

$$NP' = NP - 6.75$$

#### Adjusted Rates

Cumulative Days of Combat	NP Rate per 1000 Men per 10-Day Period From Beebe and Appel*		Adjusted Rate
1-5	12.56		5.81
6-10	27.11		20.36
11-20	48.95		42.20
21-40	73.50		66.75
41-80	95.66		88.91

\*Figures obtained from Beebe and Appel (Table 1) by linear interpolation.

## Appendix D

### Computational Procedures for Generating Curves Indicating NP Casualties Among Infantry Troops with Different Amounts of Cumulative Combat Experience, as a Function of Different Levels of Combat Intensity

2.78 = Average number of battle casualties per 1000 Infantry troops per day (from Surgeon General's data)

.11 = Adjusted slope for total battle casualties (Appendix C)

NP casualties per 1000 men per day for indicated time interval (Table 3):

<u>Combat Days</u>	<u>NP Casualties</u>
1-5	.58
6-10	2.04
11-20	4.22
21-40	6.68
41-80	8.89

Substituting the indicated values in the general equation  $NP = m x + b$  and solving for  $b$  (the number of NP casualties occurring at zero battle casualties):

<u>Combat Days</u>	<u>NP Casualties at Zero Battle Casualties</u>
1-5	.27
6-10	1.73
11-20	3.91
21-40	6.37
41-80	8.58

Equations for curves indicating NP casualties for 1000 Infantry troops with different amounts of combat experience, as a function of different levels of combat intensity:

<u>Combat Days</u>	<u>Equation*</u>
1-5	NP = .11 x + .27
6-10	NP = .11 x + 1.73
11-20	NP = .11 x + 3.91
21-40	NP = .11 x + 6.37
41-80	NP = .11 x + 8.58

\*The model provides NP estimates for groups of 1000 men. To determine NP casualties for a unit, battle casualties are adjusted to a base of 1000 and the resulting NP estimate is then adjusted to the size of the unit.

## Appendix E

### Computational Procedures for Generating Curves Indicating NP Casualties Among Armored Troops with Different Amounts of Cumulative Combat Experience, as a Function of Different Levels of Combat Intensity

$m$  = Rate of NP casualties among Armored troops as a function of number wounded in action. (Appendix B)

$m'$  = Adjusted NP rate for Armored troops as a function of total battle casualties

$$m' = \frac{4.1}{5.1} m$$

$$m' = \frac{4.1}{5.1} (.26)$$

$$m' = .21$$

NP rate for Infantry troops at zero battle casualties per division per week (Appendix B) = 4.5

NP rate for Infantry troops at zero battle casualties per 1000

$$\text{men per day} = \frac{4.5}{16(7)} = .04$$

NP rate for Armored troops at zero battle casualties per division per week (Appendix B) = 11.7

NP rate for Armored troops at zero battle casualties per 1000 men per day =  $\frac{11.7}{16(7)} = .10$

+ .06 = correction to be applied to intercept of Armored NP equations

Equations for curves indicating NP casualties for 1000 Armored troops with different amounts of combat experience, as a function of different levels of combat intensity:

Combat Days	Equation
1-5	NP = .21 x + .27 + .06 NP = .21 x + .33
6-10	NP = .21 x + 1.73 + .06 NP = .21 x + 1.79
11-20	NP = .21 x + 3.91 + .06 NP = .21 x + 3.97
21-40	NP = .21 x + 6.37 + .06 NP = .21 x + 6.43
41-80	NP = .21 x + 8.58 + .06 NP = .21 x + 8.64

## Appendix F

### Computational Procedures for Generating Curves Indicating NP Casualties Among Airborne Troops with Different Amounts of Cumulative Combat Experience, as a Function of Different Levels of Combat Intensity

$m$  = Rate of NP casualties among Airborne troops as a function of number wounded in action (Appendix B)

$m'$  = Adjusted NP rate for Airborne troops as a function of total battle casualties

$$m' = \frac{4.1}{5.1} m$$

$$m' = \frac{4.1}{5.1} (.09)$$

$$m' = .07$$

NP rate for Infantry troops at zero battle casualties per 1000 men per day (Appendix E) = .04

NP rate for Airborne troops at zero battle casualties per division per week (Appendix B) = 1.80

NP rate for Airborne troops at zero battle casualties per 1000 men per day =  $\frac{1.80}{16(7)}$  = .02

- .02 = correction to be applied to intercept of Airborne NP equations

Equations for curves indicating NP casualties for 1000 Airborne troops with different amounts of combat experience, as a function of different levels of combat intensity:

<u>Combat Days</u>	<u>Equation</u>	
1-5	NP = .07 x + .27 - .02	
	NP = .07 x + .25	
6-10	NP = .07 x + 1.73 - .02	
	NP = .07 x + 1.71	
11-20	NP = .07 x + 3.92 - .02	
	NP = .07 x + 3.89	
21-40	NP = .07 x + 6.37 - .02	
	NP = .07 x + 6.35	
41-80	NP = .07 x + 8.58 - .02	
	NP = .07 x + 8.56	